

1 of 2

## REMEDIATION WORK PLAN

MICHIGAN PLAZA  
3801-3823 WEST MICHIGAN STREET  
INDIANAPOLIS, INDIANA  
MUNDELL PROJECT NO. M01046  
IDEM VRP #6061202  
FEBRUARY 22, 2008

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VRP Project Name:	Michigan Plaza
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*Consulting Professionals for the Earth and the Environment*

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# REMEDIATION WORK PLAN

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3801-3823 WEST MICHIGAN STREET  
INDIANAPOLIS, INDIANA  
MUNDELL PROJECT NO. M01046  
IDEM VRP #6061202

Prepared for:

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February 22, 2008

Prepared by:

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February 22, 2008

Ms. Erin Brittain  
Project Manager  
Indiana Department of Environmental Management  
Voluntary Remediation Program  
MC66-30V IGCN #1101  
100 North Senate Avenue  
Indianapolis, Indiana 46204-2251

Re: **Remediation Work Plan**  
**Michigan Plaza**  
3801-3823 West Michigan Street  
Indianapolis, Indiana  
VRP Site #6061202  
MUNDELL Project #M01046

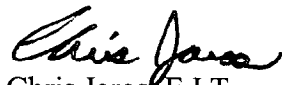
Dear Ms. Brittain:



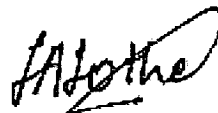
On behalf of AIMCO, owners of the above-referenced property, Mundell & Associates, Inc. (MUNDELL) is submitting this Remediation Work Plan (RWP) to the Indiana Department of Environmental Management (IDEM) for approval. This RWP provides a summary of the work activities that have been performed and remaining activities to be completed on site. We appreciate the opportunity to provide you with this information. If you should have any questions regarding the attached submittal, please call MUNDELL at (317-630-9060) at your convenience.

Sincerely,

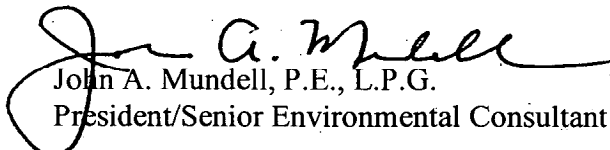
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cc: Mr. Daniel P. McNerny, Esq, Bose McKinney & Evans  
Mr. Stephen Evanoff, AIMCO



MUNDELL & ASSOCIATES, INC.

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## EXECUTIVE SUMMARY

This Remediation Work Plan (RWP) was prepared on behalf of AIMCO Michigan Meadows Holdings, LLC (AIMCO) for submission to the Indiana Department of Environmental Management (IDEM) Voluntary Remediation Program (VRP). The Michigan Plaza property is located at 3801-3823 West Michigan Street and the Michigan Meadows Apartments are directly north, located at 3800 West Michigan Street in Indianapolis, Indiana; both of which are in Indianapolis, Indiana. This document has been prepared to summarize site investigation activities to date and present the selected remediation technology chosen to address impacts that have originated on and are present beneath the Plaza property, and have also migrated into the subsurface in the southeast portion of the Apartments property. The Plaza property and the portion of the Apartments property this RWP addresses is herein termed the "Site".

The Site is located in a mixed residential/commercial and industrial area on the southwest side of Indianapolis. The Michigan Plaza consists of a single story, 'L' shaped commercial building with a number of retail and office tenants and asphalt-paved parking lots on approximately 1.5 acres of land. The Plaza currently consists of a Village Pantry (3801), a former Marion County Public Library (3805), a former Handicap Workshop (3815), a former office space (3817), Zacatecas, a Mexican grocery store (3819), and the Michigan Plaza Family Laundry (3823). The Michigan Meadows Apartments currently consists of 23 apartment buildings and one swimming pool, of which only three apartment buildings are part of the Site area this RWP addresses: Apartment Building No. 1, Apartment Building No. 6, and Apartment Building No. 10.

The results of the previous site investigations indicated that chlorinated volatile organic chemicals (VOCs) are present in the groundwater, soil, soil gas and indoor air at the Site as a result of releases from a former dry cleaner (Accent Cleaners) which occupied the current location of Unit 3819. Upgradient and background sources of chemical impacts are also present in the groundwater, soil gas and indoor air at the Site due to the former General Motors Corporation Allison Gas Turbine Division (GM AGT) Plant 10 facility located due north of the Michigan Meadows Apartments across Little Eagle Creek. The primary indicator compounds for the Site are tetrachloroethylene (PCE) and its breakdown products, including trichloroethylene (TCE), cis-1,2-Dichloroethylene (cis-1,2-DCE) and vinyl chloride (VC), which have been present above 2006 IDEM Risk Integrated System Closure (RISC) Default Commercial/Industrial and/or Residential closure levels for groundwater.

Indiana Department of Environmental Management (IDEM) was notified of this release and the Incident Number 0000198 was issued. On April 20<sup>th</sup> 2007, the Site was accepted into the VRP and assigned Site Identification Number 6061202.



This RWP outlines the proposed method of remediation to decrease concentrations of indicator compounds in the on-Site groundwater to levels below the 2006 RISC Default Commercial/Industrial Cleanup Levels. The selected remediation action involved enhancing the natural attenuation of indicator compounds at the Site by injecting CAP18<sup>TM</sup> bioremediation product into the subsurface and monitoring the plume to ensure that it continued to decrease or remain stable. CAP18<sup>TM</sup> bioremediation product was injected into the subsurface between August 1 to September 4, 2007, and monitoring activities are being conducted on a quarterly basis.

Remedial action at the Site will conclude with demonstration through confirmation sampling that 2006 RISC Default Commercial/Industrial Cleanup Levels have been achieved for indicator compounds in groundwater. A site closure report will be prepared with the anticipation of institutional controls after either closure levels have been achieved and maintained for a two-year monitoring period, or when the groundwater plume is shown to be stable or decreasing after a full seven (7) year stability monitoring period. At the time of site closure, a certificate-of-completion (CoC) and a covenant-not-to-sue (CNTS) will be sought from IDEM and the Governor's Office of Indiana

REMEDATION WORK PLAN  
MICHIGAN PLAZA  
3801-3823 WEST MICHIGAN STREET  
INDIANAPOLIS, INDIANA  
VRP SITE #6061202  
MUNDELL PROJECT NO. M01046

## 1.0 INTRODUCTION

### 1.1 PROJECT BACKGROUND

Michigan Plaza is located at 3801-3823 West Michigan Street in Indianapolis, Indiana in Marion County. The Michigan Meadows Apartments are located at 3800 West Michigan Street in Indianapolis, Indiana, directly north of Michigan Plaza. These properties are located in a mixed residential/commercial and industrial area in the southwest side of Indianapolis, as shown in **Figure 1**. A map showing the Plaza and the Apartments with the immediately surrounding areas is presented in **Figure 2a**. The current owner of the Plaza and the Apartments properties is AIMCO Michigan Meadows Holdings, LLC, (AIMCO) which has a local office at the Michigan Meadows Apartments and a local phone number of 317-244-7201. AIMCO contact person is Mr. Stephen Evanoff, in the national office in Colorado. Addresses for each of the owner contacts are as follows;

- AIMCO  
Attention: Mr. Stephen Evanoff  
4582 South Ulster Street Parkway  
Suite 1100  
Denver, CO 80237
- Michigan Plaza Manager  
Attention: Mr. Eric Davis, Community Manager  
3800 W. Michigan St. #1206  
Indianapolis, IN 46222

This RWP has been developed to address impacts that have originated on or are present beneath the Plaza property, and have also migrated into the subsurface in the southeast portion of the Apartments property. The Plaza property and the portion of the Apartments property this RWP addresses is herein termed the "Site", the area for which is shown on **Figure 2b**.



The Michigan Plaza currently consists of a single story, 'L' shaped commercial building with a number of retail and office tenants and asphalt-paved parking lots on approximately 1.5 acres of land. The Plaza currently consists of a Village Pantry (3801), a former Marion County Public Library (3805), a former Handicap Workshop (3815), a former office space (3817), Zacatecas, a Mexican grocery store (3819), and the Michigan Plaza Family Laundry (3823). The Michigan Meadows Apartments currently consists of 23 apartment buildings and one swimming pool, of which only three apartment buildings are part of the Site area this RWP addresses: Apartment Building No. 1, Apartment Building No. 6, and Apartment Building No. 10.

Records indicate that the Plaza and Apartments land was farmland/residential prior to the 1960s. The plaza building was constructed in the mid 1960s, and there have been no additions to the building after its construction. The Plaza property is currently managed locally by the AIMCO management office.

A Phase I Environmental Site Assessment (ESA) was performed by Alt & Witzig Engineering, Inc. (A & W) in June 1992 (A & W, 1992b) for the Michigan Plaza property. In the Phase I ESA, A & W identified the presence of Accent Cleaners at the 3819 West Michigan Street address during the site reconnaissance visit.

Environmental subsurface investigations conducted by a number of environmental consultants (e.g., Engineering Science, Inc.; Fluor Daniel GTI, Keramida Environmental) since 1992 have disclosed volatile organic chemical (VOC) impacts to area groundwater from the operations of the former General Motors Corporation Allison Gas Turbine Division (GM AGT) Plant 10 facility located at 700 North Olin Avenue due north of the Michigan Meadows Apartments across Little Eagle Creek. The former GM AGT has been entered into the IDEM Voluntary Remediation Program (VRP) by the Genuine Parts Company (herein termed Genuine Site).

After discovery of groundwater impacts on the Michigan Meadows Apartments property, AIMCO hired MUNDELL in 2001 to begin to review site investigation results and remedial work plans for the former GM AGT site generated by Keramida. MUNDELL then completed Phase I ESAs for both the Plaza (MUNDELL, 2003d) and the Apartments (MUNDELL, 2003e) in 2003. MUNDELL's Phase I ESA also indicated the past presence of Accent Cleaners at the Plaza property, and the 1994 and 1995 records at the Marion County Health Department that indicated the use of PCE, and documented waste management violations. Since 2003, MUNDELL has completed several subsurface investigations and indoor air quality studies for the Michigan Meadows Apartments and Michigan Plaza Site including a Phase II Environmental Site Assessment (MUNDELL, 2005b), a Further Site Characterization Study (MUNDELL, 2006b), and a Further Site Investigation Addendum I (MUNDELL, 2007a).

The results of these previous site investigations indicated that chlorinated VOCs are present in the soil, groundwater, soil gas and indoor air at the Site as a result of releases from upgradient chemical source areas located at the Genuine site located due north of the Michigan Meadows Apartments across Little Eagle Creek, as well as from the past Site operations of Accent Cleaners. The primary indicator compounds are tetrachloroethylene (PCE) and its breakdown products, including trichloroethylene (TCE), cis-1,2-Dichloroethylene (cis-1,2-DCE) and vinyl




chloride, which were present above IDEM RISC Default Commercial/Industrial and Residential Closure Levels for groundwater.

Exact amounts of chemicals released at the Genuine site have not been quantified, nor have specific release dates been determined. Groundwater impacts of cis-1,2-DCE and VC are present beneath nearly all of the Michigan Meadows Apartments (to the north) and Michigan Plaza. An absence of PCE and TCE in groundwater beneath the majority of Michigan Meadows Apartments property and the presence of PCE and TCE at Michigan Plaza indicates that a separate PCE source has been present on or near the Plaza property. Investigation activities performed by MUNDELL have concluded that historical releases of PCE into the subsurface in the vicinity of the former Accent Cleaners unit, and periodic discharges of facility wastewaters to the sanitary sewer system have dispersed the solvents into the subsurface along points in this sewer system, including areas in the southeast portion of the Apartments. It is this source of PCE from the Plaza that this RWP addresses.


In January 2007, the Site was accepted into the Voluntary Remediation Program and assigned site identification number 6061202. The Voluntary Remediation Agreement was executed by IDEM on April 20<sup>th</sup>, 2007. Several items of correspondence to and from IDEM are provided in **Appendix A**.

## 1.2 SUPPORTING DOCUMENTATION



A number of reports documenting subsurface investigations and contamination assessments described above have been completed for the Genuine Site, the Apartments and the Plaza. A subset of these supporting documents is the list of several investigations and sampling events conducted by MUNDELL in the vicinity of the Apartments and Plaza properties. These investigations and sampling events have included:

- 1) Indoor Air Studies at the Apartments and the Plaza (2002, 2003, 2004 and 2006).
- 2) Phase I Environmental Site Assessments for the Apartments and Plaza properties (2003).
- 3) Split groundwater sampling events with Keramida on the Apartments property (2003, 2004, 2005 and 2006).
- 4) Phase II Environmental Site Assessments for the Apartments and the Plaza properties (2005).
- 5) Geophysical Survey and Anomalies Investigation Report (2005).
- 6) Indoor Air Mitigation System Installation Report (2006).
- 7) Further Site Characterization Study for the Plaza (2006).
- 8) Further Site Investigation Addendum I, Michigan Plaza (2007).
- 9) 2<sup>nd</sup> Quarter Groundwater Monitoring Progress Report (2007).
- 10) Sewer Excavation Monitoring and Soil Sampling Event (2007).
- 11) Development of a Remediation Work Plan Outline (2007).




A synopsis of the results and conclusions from these investigations and sampling events relevant to the overall development of this RWP is given in **Section 2.2**. Documents and reports produced from these investigations and sampling events, along with additional supporting documents that have contributed to the overall development of this project are provided in the listing of references in **Section 4**.

### 1.3 REMEDIAL ACTION OBJECTIVES

The objective of the Site remedial activity is to decrease concentrations of indicator compounds in the on-Site groundwater to levels below the 2006 RISC Default Commercial/Industrial Cleanup Level goals. The selected remediation action involved enhancing the natural attenuation of indicator compounds at the Site by injecting CAP18™ bioremediation product into the subsurface and monitoring the plume to ensure that it continued to decrease or remain stable. CAP18™ bioremediation product was injected into the subsurface between August 1 to September 4, 2007, and monitoring activities are being conducted on a quarterly basis.

Site remedial activity also consists of the current active control of vapor concerns in the Michigan Plaza building and the proposed control systems for Apartment Buildings No. 1, 6 and 10. These remedial actions are proposed to mitigate vapor concerns below the Draft 2006 IDEM indoor air quality guidelines for the respective commercial and residential settings, during remediation, and if necessary, as a permanent engineering control if vapor concerns are not able to be permanently eliminated through groundwater remediation.



Remedial action at the Site will conclude with demonstration through confirmation sampling that 2006 RISC Default Commercial/Industrial Cleanup Levels have been achieved for indicator compounds in groundwater. Site closure with institutional controls will be pursued either when closure levels have been achieved and maintained for a two-year monitoring period, or when the plume is shown to be stable or decreasing after a full seven (7) year stability monitoring period. At the time of site closure, a certificate-of-completion (CoC) and a covenant-not-to-sue (CNTS) will be sought from IDEM and the Governor's Office of Indiana.

## 2.0 INVESTIGATION ACTIVITIES

### 2.1 SITE BASELINE INFORMATION SUMMARY


#### 2.1.1 Geologic and Hydrologic Information Summary

The regional and site-specific surface soils, geology and hydrogeology are described in the following sections. Evaluations of these has been provided previously in Sections 3.1 and 3.2 of the MUNDELL February 16, 2005 *Phase II Environmental Site Assessment* report for the Michigan Plaza, in Section 2.1.3 of the MUNDELL May 5, 2005 *Phase II Environmental Site Assessment* report for the Michigan Meadows Apartments (based on the results of a two-dimensional electrical resistivity geophysical survey), and Section 2.3 of the MUNDELL May 10, 2006 *Further Site Characterization* report for the Michigan Plaza.

#### 2.1.2 Surficial and Unconsolidated Geology

Marion County is situated within the southern part of the physiographic region known as the Tipton Till Plain, with most of the county underlain by a thick assemblage of glacial deposits located within the White River Basin. These glacial sediments, which include glacial till, randomly arranged ice contact sand and gravel, silt, lake clays, outwash sands and gravel, and alluvial materials, were deposited on a strongly dissected pre-glacial landscape formed on bedrock of highly variable resistance to erosion. The glacial drift cover in Marion County is believed to represent most of the major periods of glaciation that collectively constitute the Pleistocene Ice Age in this area of the United States. The deposits closest to the land surface are generally from the most recent period of glaciation known as the late Wisconsin age, and were formed as a result of several major ice advances into Marion County. The thickness of Wisconsinan glacial drift, which is comprised of loam till of the Trafalgar Formation and some outwash, ranges from 50 to 150 ft in the area (Fenlon et al., 1994).

The U.S. Department of Agriculture Soil Survey of Marion County, Indiana (USDA, 1991) indicates that the Site consists of Urban land-Fox complex with estimated slopes between zero and three percent. The urban land complex indicates that fifty percent of the predominant soil type has been disturbed and has been covered with an impervious layer consisting of buildings, sidewalks, streets and other structures. The undisturbed areas of the complex retain the original soil characteristics. The Fox soils are identifiable in lawns, gardens, parks and other open areas. They have a representative profile of the series, but alteration is evident in many areas where topsoil has been stripped. The Fox soil series generally consists of nearly level to moderately sloping, well-drained soils that are moderately-deep over sand and gravelly sand. The typical profile for the Fox series is as follows: the surface layer is dark brown loam 8 inches thick. The



subsoil is 30 inches thick. The upper 10 inches is dark brown friable loam; the next 6 inches is dark brown, firm sandy clay loam; and the next 14 inches is dark brown, firm gravelly clay loam.

### 2.1.3 Bedrock Geology

The bedrock beneath the unconsolidated deposits in Marion County consists of sedimentary rocks of Mississippian, Devonian and Silurian age. The bedrock surface slopes gently to the southwest. Therefore, younger Mississippian rocks are at the bedrock surface in the southwest corner of the county and progressively older Devonian and Silurian rocks are at the bedrock surface in the central and northeast portion of the county, respectively (Harrison, 1963; Fleming et al., 1993). Bedrock beneath the unconsolidated deposits at the Site is Mississippian and Devonian age New Albany Shale. The top of the bedrock surface is estimated to be between EL 625 to EL 650 above MSL.

North of the Site, an interpretation of the results of a two-dimensional geophysical survey completed along Little Eagle Creek (see Figure 3 of the Phase II ESA for the Michigan Meadows Apartments) indicated an interpreted bedrock ridge near the Creek with a depth to rock of about 40 ft bgs at the crest. This bedrock ridge appears to be a divide in the type of depositional environment oriented north-south in this area. West of the bedrock ridge, there appears to be more numerous, more irregularly-shaped well-graded sand deposits interspersed with clay deposits (fluvial in nature). East of the bedrock ridge, large gravel-filled channels are apparent, with the top of bedrock likely in excess of 120 ft at the deepest point of the valley.




### 2.1.4 Hydrogeology

The surface of Marion County consists of Pleistocene glacial deposits and recent alluvial stream deposits. While most of the glacial material in the county consists of fine-grained silts and clay, sand and gravel outwash soils are commonly found along major streams. These outwash deposits, which fill the White River Valley and its major tributaries, were deposited in a complex fashion during what is thought to have been three primary ice advances and subsequent meltwater discharges from ice margins upstream from Marion County (Fleming et al., 2000). The Wisconsin-age sediments, within the White River Valley and a variety of smaller sand and gravel and fine-grained till units are distributed in a discontinuous nature throughout the valley.

The Site itself is situated south of Little Eagle Creek within an area containing variable thickness of outwash overlying complexly interbedded sand and gravel and fine-grained glacial till. Thick unbroken sections of sand and gravel are present locally, and are typically unconfined within the upper portions of the system, and confined or semi-confined by bodies of glacial till at depth (Fleming et al., 2000). Estimated thickness of the unconfined sand and gravel outwash in the area ranges from 20 to 40 ft on top of an undifferentiated Pre-Wisconsinan glacial till (Brown and Fleming, 2000).

From local experience and published hydrogeologic data in this area (e.g., Meyer et al., 1975; Herring, 1976; Smith, 1983; Fleming et al., 2000), shallow regional groundwater levels in the vicinity are expected to range between EL 700 and EL 705 above MSL, with groundwater flow




from the Site directed towards the south-southeast in the direction of flow in Little Eagle Creek. Based on the interpretation of the results of an east-west oriented two-dimensional resistivity survey completed for the *Phase II ESA* for the Michigan Meadows Apartments immediately north of the Site near the Little Eagle Creek (see previous discussion in Sections 2.3.1 and 2.3.2), there are likely thick, more uniform hydraulically-transmissive sand and gravel deposits east and north of the Site. West and north of the Site, the well-graded sands appear to have been deposited in a more complex channelized, interwoven and tortuous manner, suggesting groundwater flow pathways to be more restricted and less transmissive than those to the east.

The Little Eagle Creek is the principal surface water feature in the area. The groundwater flow from the site is generally towards the south-southeast in the direction of flow in Little Eagle Creek.

MUNDELL reviewed water well records kept by the Indiana Department of Natural Resources (DNR) for the site vicinity. Low capacity wells listed in the DNR database are shown on **Figure 3a**. There are 79 low-capacity wells within two miles of the Site, 32 of which are within a one-mile radius. The high-capacity municipal wells are shown on **Figure 3b**. There are 43 high-capacity wells within two miles of the Site, 15 of which are within a one-mile radius. The nearest downgradient well is greater than 1.5 miles away and is located across Little Eagle Creek. Copies of the DNR water well logs are provided in **Appendix B**.

### 2.1.5 Physical and Political Geographic Information Summary




The Site lies in Wayne Township, in the SE ¼, NW1/4 of Section 5, Township 15, Range 3. It lies in the Universal Transverse Mercator Zone 16. The UTM co-ordinates are as follows:

UTM X (Meters): 566254.8


UTM Y (Meters): 4402704.0

The Site is located at the southeast corner of the intersection of Michigan Street and Holt Road in Indianapolis, Indiana. The adjacent properties are as follows: Michigan Meadows Apartments across Michigan Street to the North, residential properties to the west, recently vacated land to the east, just beyond which is the Little Eagle Creek. A recently constructed Cemetery Development parking area and retention basin is just south of the Site, beyond which are cemetery plots.

### 2.1.6 Identification of Susceptible Areas



Various grasses and forbs such as goldenrod (*Solidago* sp.), ragweed (*Abrosia* sp.), and other weedy species are present in the area. Animal species observed in this area include red-winged blackbirds (*Agelaius phoeniceus*), raccoons (*Procyon lotor*), and opossum (*Didelphis marsupialis*). A mature deciduous woodland habitat extends to the banks of Little Eagle Creek. Tree species present in this woodland include sycamore (*Platanus occidentalis*), cottonwood (*Populus deltoids*), and other deciduous tree species. This wooded area grades steeply down to the creek. The woodland canopy is dense along the creek while the understory is sparse. Animal




species observed in the wooded area include abundant bird populations, raccoons (*P. lotor*), and opossum (*D. marsupialis*).

Little Eagle Creek is a perennial stream that flows in a south-southeasterly direction in the vicinity of the Site. It originates approximately eight miles north of the Site and discharges to Eagle Creek southeast of the Site. Great blue herons (*Ardea herodias*) have been observed along the edges of the creek, although no fish have been noted in the water.

The U.S. Fish and Wildlife Services (USFWS) was contacted for information on state or federally-listed threatened and endangered species (TES), rare species, and critical habitats that are known to occur in the Site area. The USFWS response is included in **Appendix C**. Also, IDNR reported that no plant or animal species listed as state or federally threatened, endangered, or rare have been reported in the Site vicinity.

The USFWS reported the Site is within the range of the federally endangered Indiana bat (*Myotis sodalis*) and the federally threatened bald eagle (*Haliaeetus leuindicator compoundephalus*). *M. sodalis* nests in woodlands during the summer months, selecting trees with loose bark for nest sites. They forage for insects primarily over wooded stream corridors, although they have also been documented as using other habitats for foraging. *M. sodalis* have been documented in northeast Marion County and in Hendricks County in Indiana. Based on this information, the wooded area of the Site and Little Eagle Creek are potential nesting and foraging habitats for the Indiana bat.




*H. leuindicator compoundephalus* nest in close proximity to lakes, rivers, or other large surface water bodies, constructing their nests near habitat ecotones such as lakeshores and cuts within timber management areas. The West Fork White River in Morgan County, Indiana is primary wintering area for *H. leuindicator compoundephalus*, where food sources such as waterfowl and fish are available.

The Kirtland's snake (*Clonophis kirtlandii*), a species of concern, may also be present in the Site area. Although *C. kirtlandii* is not federally threatened or endangered, the USFWS and other federal and state agencies encourage consideration of this species in project planning. Finally, the USFWS noted the potential for migration of contaminants to Little Eagle Creek and nearby wetlands, with potential bioaccumulation and/or toxic effects in aquatic media organisms.

The National Wetlands Inventory (NWI) map indicates that there may be riverine wetlands (associated with Little Eagle Creek) within and adjacent to the area of interest. Water and other habitat resources are attractive to numerous wildlife species. In particular, migratory birds such as wood ducks (*Aix sponsa*), mallards (*Anas platyrhynchos*), and tree swallows (*Tachycineta bicolor*) will utilize open water wetlands and are subject to potential impacts from contaminants.

The Little Eagle Creek is the principal surface water feature in the area. The groundwater flow from the site is generally towards the south-southeast in the direction of flow in Little Eagle Creek. A 100-year flood zone exists within 1/8<sup>th</sup> of a mile to the north-northeast side of the site.




A 500-year flood zone is identified at approximately 1/4<sup>th</sup> of a mile to the south-southwest side of the site.

The Site is not located within a Marion County wellhead protection area (Refer to Appendix F, Phase I Environmental Site Assessment, MUNDELL, December 2003). The Site is, however, located within one of seven designated Marion County Health Department (MCHD) No Well Zones (NWZs). Since the MCHD requires permits for all water supply wells in the county, the purpose of the NWZs designation is to provide short-term protection of human health until the impacted groundwater is remediated by responsible parties. This designation in the area of the Site currently supports the likelihood there will be no future potable wells in close proximity to the Site.

No karst bedrock areas are known to exist in the vicinity. A copy of the letters received from IDEM, IDNR, MCHD, IGS, and USFWS are included in **Appendix C**.

### **2.1.7 Summary of Historic Water and Chemical Use on Site**

The city of Indianapolis supplies drinking water and sewage service to the Site.




The *Phase I ESA* indicated the historical existence of a dry cleaners on-site (Accent Dry Cleaners: 3819 W. Michigan Street - Michigan Plaza) that is the cause of environmental impacts at the Site due to the past use of hazardous substances (*i.e.*, PCE) from the previous dry cleaning operations. There is no longer PCE storage at this unit as it is currently operating as a restaurant. There are typical household cleaning items in the various tenants in the Plaza units, none of which are considered to present significant environmental hazards.

## **2.2 SITE SUBSURFACE INVESTIGATION SUMMARY**


A number of investigations, monitoring and sampling events have been conducted in the vicinity of the Apartments and Plaza properties in the process of developing the selected remedial method. These following sections present a synopsis of activities, results and conclusions from previously prepared documents.

### **2.2.1 Keramida March 2002 Phase II Investigation**



As a part of the *Phase II* investigation for the 2002 *Remediation Work Plan (RWP)* (March 2002; October 2002) associated with the Genuine Site north of Little Eagle Creek, Keramida conducted off-site subsurface sampling for VOCs, including testing at 3800 to 3823 West Michigan Street and the surrounding areas. Groundwater samples taken by Keramida from both the shallow and deep groundwater systems in the area indicated chlorinated solvent groundwater impacts (most notably cis-1,2-DCE and vinyl chloride) beneath the Plaza (refer to Appendix I, MUNDELL *Phase I ESA*, December 2003, Figures 20, 21 and 22 from this report). These *Phase II* results, summarized on organic chemical groundwater plume maps, established a clear connection between the groundwater contamination found at the former GM AGT Plant 10 facility and the





groundwater contamination detected beneath the Michigan Meadows Apartments and at the Michigan Plaza.

### 2.2.2 Keramida October 2002 RWP and August 2004 RWP

In October 2002, Keramida submitted a *Remediation Work Plan (RWP)* to the IDEM VRP that outlined its plans for the remediation of the former GM AGT Plant 10 facility. In August 2004, Keramida submitted a revised *RWP* based on comments received by IDEM. Both *RWPs* show groundwater flowing south from the former GM AGT Plant 10 facility to Michigan Meadows Apartments and Michigan Plaza and clearly demonstrated that the former GM AGT Plant 10 facility is directly upgradient of the property and the likely sole source of groundwater impacts beneath most of the Michigan Meadows Apartments site and a contributing source to the Michigan Plaza Site.

### 2.2.3 MUNDELL April 2003 Air Quality Study

Indoor air sampling performed by MUNDELL on December 10, 2001 had detected the presence of volatile organic chemicals at low concentrations in several apartment buildings basement areas in the northwestern portion of the Michigan Meadows Apartments property nearest the former GM AGT Plant 10 facility. These findings, along with a review of the subsurface investigations and remediation conducted by Keramida as part of the VRP activities for that site, raised a concern that additional investigations at the Michigan Meadows Apartments and the Michigan Plaza were warranted to further define the severity of groundwater impacts, and the resulting potential impact on indoor air quality for the facilities. As such, MUNDELL completed a more comprehensive indoor air quality investigation during April 2003 designed to detect potential impacts at the Site that could pose a human-health concern to the current residents and tenants. Air samples were collected from 23 Michigan Meadows Apartments buildings (Bldg Nos. 1 through 23) and 4 tenant units (3801, 3805, 3815 and 3817 West Michigan) at the Michigan Plaza Shopping Center.

The results of this investigation indicated that the tenant units in Michigan Plaza Shopping Center were above the draft U.S. EPA guidance indicator indoor air concentrations and IDEM draft default concentrations (at that time) for PCE and TCE.

### 2.2.4 MUNDELL November 2003 Phase I Environmental Site Assessment

Subsequent to the 2003 indoor air study, MUNDELL performed a detailed *Phase I Environmental Site Assessment* of the Michigan Plaza site in November 2003. The *Phase I ESA* indicated the historical existence of a dry cleaners on-site (Accent Dry Cleaners: 3819 W. Michigan Street - Michigan Plaza) that posed a potential environmental concern for the Site due to the past use of PCE from the previous dry cleaning operations. It also indicated the presence of known groundwater impacts in the area and other areas of off-site environmental concern, including groundwater impacts from the former GM AGT Plant 10 facility located north of the Site. Based on the *Phase I ESA* findings and conclusions, MUNDELL recommended the

advancement of additional soil borings and groundwater sampling on the Site in the vicinity of the former dry cleaners to determine potential impacts from the former operations.

### 2.2.5 MUNDELL October 2004 Air Quality Study

Another round of air sampling was conducted by MUNDELL in October 2004 that included sampling of the prior highest PCE/TCE air concentration tenant units at Michigan Meadows Apartments and Michigan Plaza Shopping Center. Air samples were collected at two of the 23 Michigan Meadows Apartment buildings and in two of the tenants of Michigan Plaza Shopping Center. In addition, one below-driveway slab air sample was collected behind the Mexican grocery store in the Plaza, and from the unsaturated soil zone of three (3) of the gas monitoring wells. The air samples from the two tenant locations at the Plaza indicated airborne concentrations above both the current draft U.S. EPA guidance indicator indoor air concentrations and the IDEM draft default concentrations for PCE.

### 2.2.6 MUNDELL August/September 2004 Phase II Investigation – Apartments

A *Phase II Environmental Site Assessment* study along the northern portion of the Michigan Meadows Apartment property was conducted by MUNDELL in August and September 2004 that included the installation of seven (7) groundwater monitoring wells (MMW-1S, MMW-2S, MMW-3S, MMW-4D, MMW-5D, MMW-6D and MMW-7S) with soil sampling and testing of groundwater, and a geophysical survey to assess geology. **Figure 4** shows the locations, **Figure 5** shows the geophysics results, and **Figure 6** and **Figure 7** show the soil and groundwater analytical results, respectively, which are also summarized in **Table 1** and **Table 2**. The results indicated VOC impacts (cis-1,2-DCE and VC) coming onto the property from the former GM Plant 10 facility.

### 2.2.7 MUNDELL August/September 2004 Phase II Investigation – Michigan Plaza

The October 2004 *Phase II Environmental Site Assessment* activities were conducted by MUNDELL at the Michigan Plaza property located at 3801-3823 West Michigan Street, Indianapolis, Indiana to determine the source and delineate the extent of the soil and groundwater volatile organic chemical impacts. The on-site activities necessary to complete this assessment included completion of five (5) geoprobe soil borings (GP-01, GP-02, GP-03, GP-04 and GP-05), all of which allowed soil and groundwater sampling and testing. **Figure 8** and **Figure 9** show the soil and groundwater analytical results respectively, which are also summarized in **Table 3** and **Table 4**. In addition, air sampling (indoor air, soil gas wells, and below slab) was performed by MUNDELL as a part of this site investigation.

Two VOC chemicals, PCE and cis-1,2-DCE, were detected in soil samples taken from above the groundwater table at the Site. None of the soil samples collected had VOC concentrations above their respective 2006 IDEM RISC Default Commercial/Industrial cleanup levels. Detectable levels of nine VOCs (PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, chloroform, vinyl chloride, methylene chloride, toluene and acetone) were observed in the groundwater collected beneath the Site. Groundwater samples tested from three (3) of the five (5) boring locations contained

detectable levels of PCE above the 2006 IDEM RISC Default Residential closure level. The most significant PCE levels were observed behind and immediately downgradient of the former dry cleaning facility space within the Plaza building. These PCE concentrations exceeded the 2006 IDEM RISC Default Industrial closure levels at this location, and ranged from a maximum of 730 ug/L at a depth of 20 ft bgs (within one foot of the top of the groundwater table) to 11 ug/L at a depth of 40 ft bgs (or at about 20 ft below the top of the groundwater surface).

### 2.2.8 MUNDELL July 2005 Geophysical Survey and Anomalies Investigation

A geophysical survey was conducted on February 18, 2005 by MUNDELL using electromagnetic techniques in order to map on-Site subsurface features at the Plaza to aid in the identification of potential on-Site chemical source areas and release pathways. Results of this survey prompted test pit excavations in three locations, one of which (TP-3) was immediately south and behind the former location of the dry cleaners. In TP-3, a sewer line was confirmed and soil sampling revealed PCE concentrations above residential but below industrial IDEM RISC Default Closure values. **Figures 10 to 12** show locations and data from the survey, and **Table 5a** summarizes the soil analytical results from test pit TP-3. These results helped guide the *Further Site Characterization* activities.

### 2.2.9 MUNDELL May 2006 Further Site Investigation Report – Michigan Plaza

The *Further Site Characterization* activities were conducted at the Site from September 26, 2005 through December 2005 to confirm an onsite chemical source at Michigan Plaza, and to delineate chemical impacts to soil and groundwater from past Site operations. On the Plaza property, three Geoprobe borings were advanced (GP-6, GP-7 and GP-8), six shallow monitoring wells were installed (MMW-P-01, MMW-P-02, MMW-P-03S, MMW-P-04, MMW-P-05 and MMW-P-06) and one deep monitoring well was installed (MMW-P-03D). On the Apartments property, five Geoprobe borings were advanced (GP-A-01, GP-A-02, GP-A-03, GP-A-04 and GP-A-05). **Figures 13 to 15** show boring and monitoring well locations and analytical results, and **Tables 5b through 8** summarize analytical results.

Further sewer line investigation was also performed by collecting liquid samples from five different sewer locations running along Michigan Street, which showed detectable concentrations of PCE, as summarized on **Table 9**. A video-taping camera was also used inside sewer locations to identify cracked/worn out joints and offset (see **Figure 16** for locations and **Figure 17** for analytical results). As a result of the present *Further Site Characterization* study, sewer lines were identified as a subsurface contaminant transport pathway contributing to groundwater contamination, primarily of PCE in shallow groundwater in three distinct *Source Areas* (A, B and C) at the Site. **Figures 18 to 22** illustrate shallow and deep groundwater plume configurations for each of the indicator compounds, **Figure 23** shows the potentiometric groundwater surface across the Site at that time, and **Figures 24 to 26** illustrate geological cross-sections for the Site.

A follow up indoor air sampling event was also conducted by MUNDELL in September 2005, which included sampling of the prior highest PCE/TCE concentration units at the Plaza. Further

discussion on indoor air sampling is given in **Section 3.2.1.3**, **Section 3.3**, and the data is presented in **Appendix E**.

## 2.2.10 MUNDELL April 2007 FSI Addendum I Report – Michigan Plaza

*Further Site Investigation Addendum I* investigation activities were performed by MUNDELL from September 2006 through February 2007 at the request of IDEM to address outstanding concerns regarding the existence and extent of potential releases of the PCE and TCE from the sewer line connected to the Michigan Plaza (primarily in *Source Area B* and *Source Area C*), to delineate downgradient extents of impacts from the Plaza (*Source Area A*), and to evaluate if Site releases could impact the ecological health and surface water quality and biota in Little Eagle Creek. Results of these activities are summarized in detail in the MUNDELL April 1, 2007 *Further Site Investigation Addendum I*, Michigan Plaza (MUNDELL, 2007A).

Several shallow soil borings were advanced in close proximity of the sewer line relative to sewer invert SS-A-1 in the upflow direction (Geoprobe locations GP-A-06, GP-A-07, GP-A-08, and GP-A-09) and several borings were advanced and converted into monitoring wells in the downgradient direction in *Source Area B* (MMW-8S, MMW-P-07 and MMW-P-08) and *Source Area C* (MMW-9S and MMW-10S). Additional vertical groundwater profiling (depths of 20, 30 and 40 feet bgs) was also performed in these locations, positioned to be downgradient of the suspected sewer release areas.

Additional soil and groundwater sampling was also performed downgradient of *Source Area A* by advancing Geoprobe borings near the intersection of Cossell Road and Olin Avenue (GP-C-01, GP-C-02, GP-C-03, GP-C-04 and GP-C-05), followed by the installation and sampling of a shallow monitoring well at that intersection (MMW-P-09). All drilling locations can be seen on **Figure 27** and **Figure 28**, which include soil and groundwater analytical results respectively, as do **Table 10** and **Table 11** respectively.

A complete groundwater sampling event was performed on February 21-22, 2007 from each of the newly installed six (6) monitoring wells as well as twenty-four (24) previously existing monitoring wells for a total of 30 wells sampled across the wider area of Site monitoring. included in the current FSI Addendum I study sampling event program (*i.e.*, MUNDELL monitoring wells MMW-1S, MMW-2S, MMW-3S, MMW-4D, MMW-5D, MMW-6D, MMW-7S, MMW-8S, MMW-9S, MMW-10S, MMW-P-01, MMW-P-02, MMW-P-03S, MMW-P-03D, MMW-P-04, MMW-P-05, MMW-P-06, MMW-P-07, MMW-P-08, MMW-P-09; and Keramida monitoring wells MW-167S, MW-167D, MW-168S, MW-168D, MW-169S, MW-169D, MW-170S, MW-170D, MW-171S and MW-171D). Groundwater analytical results are shown on **Figure 29** and the potentiometric surface at that time is provided on **Figure 30**. **Figures 31A**, **31B**, **31C** and **31D** illustrate updated shallow groundwater plume configurations for each of the indicator compounds, and **Figure 32A** and **Figure 32B** illustrate the updated deep groundwater plume configurations for each of the indicator compounds.

In order to investigate the potential for ecological impact to surface water and biota in the Little Eagle Creek, surface water sampling was conducted at three locations (one upstream (MSW-1)

of the Michigan Plaza PCE release areas, and two downstream (MSW-2 and MSW-3) on the Little Eagle Creek meandering east of the Michigan Plaza site, on February 21, 2007. The analytical results for the contaminants of concern were below method detection limits for all VOC indicator compounds at each of the locations. The surface water analytical testing results are summarized in **Table 12** and presented on **Figure 32C**.

Based on the results of the *FSI Addendum I* study, the following conclusions were drawn:

- 1) Releases of PCE and TCE from the sewer appear to be confined to the south-central (*Source Area B*) and south-eastern (*Source Area C*) locations previously indicated in the *FSI*, and were not detected in the western portion of the Michigan Meadows Apartments property.
- 2) The horizontal extent of PCE releases associated with the east-west sewer line system and connected piping are consistent with the previous *FSI* results (see **Figure 18** and **Figure 31A**), and indicate PCE releases in areas near sewer line system intersections and joint locations as previously determined (see **Figure 16**). The vertical extent of these releases appears to be most severe in the shallow, upper 10 ft of the saturated aquifer, with lesser impacts observed at depths of up to 40 ft below the existing ground surface.
- 3) Initial groundwater sampling and testing downgradient of the Michigan Plaza indicates that detectable PCE impacts may extend in a limited fashion as far south as the intersection of Cossell Road and Olin Avenue. (note, however subsequent analytical data from the last three quarterly monitoring events has shown no detectable PCE impacts in this area).
- 4) Based on the non-detect results of the surface water testing performed on Little Eagle Creek, there does not appear to be any significant potential for ecological impact to the biota or the surface water in the Creek at the present time.
- 5) Groundwater sampling results also indicate there are chemical impacts within the deeper aquifer which are likely from further upgradient releases from the Genuine Site north of the Michigan Meadows Apartments. As such, there are limited zones of co-mingled chemical compounds (specifically cis 1-2 DCE and vinyl chloride).

#### 2.2.11 MUNDELL Quarterly Monitoring Progress Report – 2<sup>nd</sup> Quarter 2007

Further site characterization and groundwater sampling activities were performed from April 1 through June 30, 2007, the details of which are documented in MUNDELL August 15, 2007 *Quarterly Monitoring Progress Report – 2<sup>nd</sup> Quarter 2007*, Michigan Plaza (MUNDELL, 2007C). Based on a meeting held with IDEM on May 25<sup>th</sup>, 2007, it was agreed deeper monitoring wells (35 to 50 feet deep) would be installed near monitoring wells MMW-8S, MMW-P-07 and MMW-P-08 and downgradient of MMW-P-03D to further delineate and monitor the extent of impacts from chemical source *Areas A, B* and *C*. Four (4) additional permanent monitoring wells (MMW-11S, MMW-P-10S, MMW-P-10D, and MMW-P-09D) were installed from May 31<sup>st</sup> through June 1<sup>st</sup>, 2007 in the locations illustrated on **Figure 33**.

On June 14<sup>th</sup>, 2007, MUNDELL personnel sampled what was proposed as the quarterly groundwater monitoring network, which based on IDEM's approval during the May 25, 2007 meeting, consists of the following twenty (20) monitoring wells:

- 1) *Four (4) new MUNDELL monitoring wells:* MMW-11S, MMW-P-10S, MMW-P-10D, and MMW-P-09D.
- 2) *Fourteen (14) existing MUNDELL monitoring wells:* MMW-1S, MMW-8S, MMW-9S, MMW-10S, MMW-P-01, MMW-P-02, MMW-P-03S, MMW-P-03D, MMW-P-04, MMW-P-05, MMW-P-06, MMW-P-07, MMW-P-08, and MMW-P-09.
- 3) *Two (2) Keramida monitoring wells:* MW-168S and MW-168D

One soil sample was obtained from MMW-P-10S, the results for which are summarized on **Table 14** and illustrated on **Figure 33**, along with new monitoring well locations. The potentiometric surface from June 14, 2007 is provided on **Figure 34**, and groundwater analytical results are shown on **Figure 35**, which are also summarized on **Table 13**. An updated PCE groundwater plume map (June 2007) is presented as **Figure 36**. Of particular note, this delineation shows pre-injection indicator compound PCE extents, with a shorter plume extent in *Source Area B* than had previously been anticipated.

## 2.3 SUMMARY OF SITE INVESTIGATION RESULTS

### 2.3.1 Site Indicator Compounds

Throughout the investigation studies and monitoring that have been conducted, detectable levels of nine (9) VOCs (PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, VC, chloroform, methylene chloride, naphthalene, and 1,2,3-trichlorobenzene) have been observed in the groundwater. Three compounds have been detected on some occurrences (methylene chloride, toluene and acetone) which are believed to have been laboratory artifacts and not representative of groundwater conditions at the Site. Of these VOC compounds, only **PCE, TCE, cis-1,2-DCE** and **VC** have been present above 2006 RISC Default Commercial/Industrial or Residential Cleanup Levels. Of these four VOC indicator compounds, a determination regarding appropriate closure levels for the cis-1,2-DCE and VC will need to be established, as is further discussed in **Section 2.5**. The only detectable compounds in soil above 2006 RISC Default Commercial/Industrial or Residential Cleanup Levels have been PCE, TCE, cis-1,2-DCE, and trans-1,2-DCE. Many of these samples, however, were obtained beneath or at the water table and in most cases are more indicative of groundwater impacts than soil impacts.

### 2.3.2 Site-Specific Geology and Hydrology

The soil stratigraphy encountered during the advancement of the soil borings across the Site was a fairly uniform 0.5 to 3.0 ft surficial sand and gravel (base course) and clayey fill overlying a natural, fine-grained silty clay layer (a low plasticity CL, according to the Unified Soil Classification System) near the ground surface down to a depth of about 3.5 to 8.0 feet bgs. This layer overlies a well-graded, gravelly sand (SW) layer that was encountered down to a depth of about 9.5 ft to 18.5 ft bgs. Beneath this well-graded layer, a poorly-graded, fine to medium sand (SP) with little to no fines was encountered down to a depth of about 11.5 feet to 19.5 feet bgs.

The top of the unconfined groundwater table was encountered within this layer between about 18 to 19 ft bgs, with the exception of boring GP-02 where the water table was encountered at nine (9) feet bgs. This layer overlies a well-graded, gravelly sand (SW) layer that was encountered down to a depth of about 30 ft bgs. Additional detailed lithological descriptions of these areas may be obtained from the boring logs provided in **Appendix D**. Two geologic cross sections (A-A') and (B-B') depicting the subsurface stratigraphy across the Site from north to south, and from east to west respectively are presented as **Figures 25 and 26**.


Two-dimensional resistivity mapping north of the Site near the Little Eagle Creek completed for the *Phase II Environmental Site Assessment* for the Michigan Meadows Apartments indicated a subsurface beneath the interpreted water table that may not consist of simple horizontal stratigraphic sequences, but rather exhibits numerous bowl-shaped "pods" suggesting possible channels or valleys in their morphology. The interpretation (see **Figure 5**) of the depositional history of these coarse-grained (sands, gravels, cobbles) unconsolidated materials is one of a high-energy, fluvial system of braided channels proximal to a melting glacier margin.

### 2.3.3 Sources of Contamination

Chemical source areas for the Genuine site are summarized in the Keramida Environmental March 29, 2002 *Phase II Investigation Report* (Keramida Figures 19a, 19b, 20a, 20b, 21a, 22a and 22b) and the Keramida August 16, 2004 Remediation Work Plan (Keramida Figures 14c, 14d and 20). Based on these results demonstrating this upgradient source, widespread groundwater impacts of cis-1,2-DCE and VC from the Genuine site have been determined to be present in the area above IDEM RISC commercial/industrial and residential cleanup goals, including and extending south of both the Apartments and the Plaza. Discussion of these indicator compounds contributing to background conditions is provided in **Section 2.4**.

The shallow PCE chemical source areas directly related to the Site have been delineated, verified and documented in three recent reports: MUNDELL May 10, 2006 *Further Site Characterization Report*, Michigan Plaza (see **Figure 18**), MUNDELL April 1, 2007 *Further Site Investigation Addendum I*, Michigan Plaza (see **Figure 31A**), and the MUNDELL 2007 2<sup>nd</sup> Quarter Groundwater Monitoring Progress Report (**Figure 36**). Additionally, the sewer line liquid sampling, camera investigation, and soil sampling in the sewer tie-in activities all confirms the distribution as reported. The three source areas identified during the Site characterization process are as follows:

- **Source Area A** (beneath the Michigan Plaza building, with the plume centering longitudinally and originating in the former location of Accent Cleaners (Currently Zacatecas Restaurant - Unit 3819), extending off site south-southeast of the Plaza building) into the cemetery property,
- **Source Area B** (off site north of Michigan Street south of Building No. 10 and Building No. 6 at the Michigan Meadows Apartments from the leaking sewer line), and

- 
- **Source Area C** (south-southeast of monitoring well MMW-1S, off site north of Michigan Street and south of Building No. 1 at Michigan Meadows Apartments from the leaking sewer line).

### 2.3.4 Summary of Horizontal and Vertical Extent of Contamination


Groundwater plume maps from the most recent annual groundwater testing (February 2007, seen on **Figures 31A, 31B, 31C, 31D, 32A, and 32B**) and the June 2007 quarterly sampling (**Figure 36**) confirm the source areas, delineate the horizontal and vertical extent of contamination, and give an indication of background cis-1,2-DCE and VC impacts coming into the Site. The PCE plumes in the three *Source Areas* are a result of leaking sewer lines (cracks, worn-out joints) that allowed PCE, and to a lesser degree the daughter products of PCE (TCE, cis-1,2-DCE and VC), to be released through the sewer from the former dry cleaning operations to enter the subsurface.

Vertical groundwater extents of the indicator compounds in selected areas can best be seen on **Figure 28**, which shows the distribution of PCE and TCE most concentrated in the upper 10 feet of the saturated zone, with diminishing levels beneath these depths down to the clay till which was documented during the August 2007 injection activities to be as shallow as 21 feet bgs, but generally observed in the range of 30 to 45 feet bgs (see **Figure 44**). Based on the vertical distribution of the cis-1,2-DCE and VC impacts at the Site, the impacts to the deeper groundwater system are likely caused by releases from the former Genuine Site. However, some of the shallow groundwater system cis-1,2-DCE and VC impacts detected near Michigan Street may be in part attributable to the *Source Areas* associated with the Michigan Plaza. These impacts could be a result of PCE breakdown possibly occurring and migrating from the on-Site source areas.

The horizontal extent of TCE impacts in shallow groundwater are summarized in **Figure 31B**. As indicated, maximum TCE concentrations are observed in *Source Area B* immediately south of the east-west sewer line connection with the Michigan Plaza sewer line, and range from 281 to 356 ug/L in wells MMW-P-08 and MMW-P-07, respectively. *Source Area C* has TCE groundwater concentrations ranging from 15 to 80 ug/L in a limited area around the east-west sewer line connection with the north-south Michigan Meadows Apartments sewer line (wells MMW-10S and MMW-9S, respectively), decreasing to 8.8 ug/L downgradient and immediately south of Michigan Street (well MW168S). TCE impacts are not observed within *Source Area A*, since levels were observed to be below method detection limits along the southern property line of Michigan Plaza.

The distribution of cis-1,2-DCE impacts to the shallow and deep aquifer system are illustrated in **Figure 31C** and **Figure 32A**, respectively. As indicated in the shallow aquifer (**Figure 31C**), cis-1,2-DCE appears to be present at a maximum concentration of 274 ug/L in the central portion of the Michigan Plaza property (well MMW-P-01) north of *Source Area A* and south of *Source Area B*. More limited cis-1,2-DCE shallow groundwater impacts are observed immediately downgradient of *Source Area C*, with a maximum concentration of 155 ug/L observed in well






MW-168S. Both shallow impacted areas (*Source Areas A and B, Source Area C*) appear to be related to the degradation of dissolved PCE and TCE parent solvents released near the sewer connections as they are transported downgradient.

Deep aquifer impacts indicate continued cis-1,2-DCE releases being transported onto the northern property boundary of Michigan Meadows Apartments from the Genuine Site and being distributed more broadly across both the Michigan Meadows Apartments and Michigan Plaza properties. Maximum concentrations (1,460 to 3,970 ug/L) have been observed along the northern property boundary of the Apartments in wells MMW-4D and MMW-5D, respectively.

**Figure 31D** and **Figure 32B** provide the distribution of VC concentrations within the shallow and deep aquifer system, respectively. As indicated, shallow VC impacts are limited within the shallow aquifer (**Figure 31D**), with maximum concentrations of less than 40.6 ug/L within *Source Areas A and B* (well MMW-8S), and less than 29.6 ug/L within *Source Area C* (well MW-168S). Deeper VC groundwater impacts are more widespread (**Figure 32B**), and are consistent with a significant VC source coming onto the northern property line of the Michigan Meadows Apartments from the Genuine Site. Southwest and cross-gradient of Michigan Plaza, monitoring well MW-170D appears to have an elevated VC concentration (105 ug/L) which does not appear to fit with either a VC from Genuine or the Michigan Plaza, and may be the result of another off-site source.




A composited map showing the soil samples collected at and near the Site during these studies is provided as **Figure 37**. Again, the only detectable compounds in soil above 2006 RISC Default Commercial/Industrial or Residential Cleanup Levels have been PCE, TCE, cis-1,2-DCE, and trans-1,2-DCE; however, many of these samples were obtained beneath or at the water table and in most cases are more indicative of groundwater impacts than soil impacts.

## 2.4 SUMMARY OF RISKS ASSOCIATED WITH SITE

The inhalation pathway has been a human exposure pathway of concern, since concentrations of PCE and TCE in indoor air have consistently been detected above both the current draft U.S. EPA guidance indicator indoor air concentration and the IDEM draft default vapor intrusion concentration, but below OSHA PELs.

As a part of the *Further Site Characterization*, MUNDELL performed indoor air monitoring at the plaza which demonstrated elevated volatile organic chemical (VOC) levels as a result of vapor intrusion from the sub-slab area. MUNDELL installed an indoor air mitigation system in September 2006 per our analysis and the Indiana Department of Environmental Management's (IDEM's) recommendation. The goal of this system is to apply a vacuum on the sub-floor slab air environment and discharge the collected air to safe outside locations, thus alleviating the indoor air quality concerns from subsurface chemical impacts at the Michigan Plaza. All the four units were tuned up and began full-time operation on September 21<sup>st</sup> 2006.



A follow-up indoor air sampling event to evaluate post-installation mitigation system effectiveness was conducted by MUNDELL in October 2006. The air mitigation systems have reduced the indoor air concentrations by about 95 % of their previous concentrations and indoor air concentrations now either meet or are only slightly above IDEM new draft April 2006 commercial levels. Further discussion on indoor air risk considerations is given in Section 3.3.

Ingestion of impacted groundwater is unlikely due to the lack of drinking water wells in the area and the current NWZ designation of the area by the Marion County Health Department. Surface water testing and plume delineation activities have determined no detectable impacts to Little Eagle Creek water quality and, as such, no ecological risks are foreseen.

The Site will remain a commercial property for the foreseeable future. It is anticipated that institutional controls including, at minimum, deed restrictions on the use of on-Site groundwater, will be put in place at the time of Site closure.

## 2.5 SUMMARY OF BACKGROUND CONCENTRATION ASSESSMENT

Groundwater and Air are the two media that present background concentration considerations for this Site. Based on the wide distribution of cis-1,2-DCE and VC impacts in the deeper groundwater system from the Genuine site, there will be the need in the future to further determine and quantify, in cooperation with IDEM, the background concentrations migrating into the Site at the time of site closure. This will allow a final determination of cis-1,2-DCE and VC cleanup goals associated with on-site remedial activities. Furthermore, additional ambient air samples will allow for the assessment of background air quality in the area at the time of site closure.

### 3.0 REMEDIATION PLAN

The remedial action objectives for this voluntary remediation are as follows:

- to decrease groundwater concentrations released from the Site on the Plaza and a portion of the Apartments properties, and any related impacts downgradient from this Site to below the 2006 RISC Commercial/Industrial Default Cleanup Levels or background concentrations for indicator compounds that have been present from the Genuine Source.
- to decrease air concentrations in the Plaza buildings to below the IDEM draft April 2006 commercial limits, or background (ambient) concentrations for indicator compounds that have been detected.
- to decrease air concentrations in affected Apartment buildings to below the IDEM draft 2006 residential limits, or background (ambient) concentrations for indicator compounds that have been detected.

Since the susceptible area assessment revealed no critical or sensitive habitat on-Site, and no public or private water supplies are threatened, these closure levels for the Site were deemed appropriately protective of human health and the environment.


### 3.1 PRELIMINARY EVALUATION OF REMEDIAL ALTERNATIVES

Four remedial alternatives were considered as potentially feasible for remediation of the chlorinated solvent contaminants in the groundwater and reduction of indoor air intrusion at the Site. The remedial alternatives which were considered include:

- 1) Monitored Natural Attenuation,
- 2) Air Sparge with Ozone Injection Combined with Soil Vapor Extraction,
- 3) In-situ Chemical Oxidation, and
- 4) In-situ Bioremediation.

These remedial alternatives were generally evaluated based on the fourteen (14) criteria outlined in the RISC Users Guide. The following four (4) criteria were of primary concern:

- 1) Protectiveness of human health;
- 2) Extent of remediation effort necessary based on the co-mingled plume;
- 3) East of technology application or implementation, given the three separate source areas; and




#### 4) Short and long-term costs of implementing each technology.

An evaluation matrix for the four remedial alternatives is included in **Table 15**. Description of the details considered for each of the technologies is provided below.

**Monitored Natural Attenuation** (MNA) is the remediation of chlorinated solvents by natural processes such as biodegradation, sorption, dispersion, volatilization, and dilution. The primary advantage of MNA is that it is a passive approach, requiring no mechanical equipment, instead relying on natural processes and long-term monitoring. The primary disadvantages of this method include the potentially long period of time needed to achieve cleanup goals, and the lack of control of degradation rates. Typically, PCE and TCE tend to breakdown to daughter components best under anaerobic conditions, where cis-1,2-DCE and VC breakdown best under aerobic conditions. Given the shallow aquifer geochemistry at the Site (highly aerobic) and the observed persistence of PCE and TCE in the identified source areas since their release, MNA alone may not facilitate the breakdown of these chlorinated compounds in the source areas at a rate that will result in the achievement of cleanup goals in a reasonable period of time. However, MNA (with Plume Stability Monitoring) following in-situ bioremediation is a viable option and is discussed further in **Section 3.2**.

**Air Sparging (with Ozone Injection) and Soil Vapor Extraction (AS/SVE)** is the process of injecting air (with ozone addition) below the groundwater surface and vacuuming air from the unsaturated zone above the groundwater surface to enhance the volatilization and removal of organic chemicals from subsurface soils and groundwater. The advantage of the technology is its general acceptance among consultants and regulatory personnel and proven track record for cleaning up sandy sites having groundwater impacted with volatile organic chemicals, including chlorinated solvents and their breakdown constituents. Its primary disadvantages are the high capital equipment and operation and maintenance costs and its inability to effectively treat sites with clayey subsurface conditions. Because of the sandy Site conditions and presence of VOCs, AS/SVE (enhanced with ozone) was considered a viable remedial technology for the site and is discussed further in **Section 3.2**.

**In-Situ Chemical Oxidation** involves injecting oxidizing chemicals (such as permanganate, hydrogen peroxide or ozone) into the groundwater or unsaturated soil. Organic contaminants are removed by chemical oxidation, producing carbon dioxide and water as byproducts. The applicability of this technology relies to some extent on the permeability of the media being treated and the type of contaminant to be oxidized. The advantages of this technology are the potential for a rapid rate of reaction (*e.g.*, in some cases as little time as 20 weeks of treatment are required in optimal subsurface conditions), and the lack of the requirement for remaining on-Site treatment equipment for certain injection applications. The primary disadvantages of this technology are the high initial cost, the potential for health and safety concerns during treatment, and the lack of demonstrated effectiveness in some Indiana fine-grained soils. The ability to evenly distribute oxidizing chemicals throughout the soil matrix while the injected chemicals are 'active' is necessary for the successful application of this technology. While the injection of permanganate and hydrogen peroxide were not considered viable at the site due to limited access



beneath Michigan Street and the Plaza building, the use of ozone as a sparging gas was considered viable as a potential treatment technology.

**In-Situ Bioremediation** involves injecting a bioremediation catalyst (such as molasses, whey or vegetable/soybean oil) into the groundwater or unsaturated soil for the purposes of enhancing natural biotic degradation of contaminants. The bioremediation agent selected, CAP18™, is a refined, food-grade soybean oil, produced by DBI Remediation Products, LLC., that stimulates anaerobic bioremediation of chlorinated hydrocarbons via a reductive dechlorination pathway. The primary advantages of this technology are that it is non-disruptive in nature, does not require on-going maintenance activities, and does not present a threat to human health or environmental quality since the soybean oil is food-grade quality. Since impacted groundwater is not removed from the subsurface or treated and then discharged above the ground surface, there are no concerns with direct contact with the water, and as such, no possibility of direct human or ecological exposure. Since the product is food-grade quality, there is no risk for either dermal contact or ingestion, even during injection. In addition to the decreased risk of environmental impact by using this method, it also causes essentially no disturbance to the Site and surrounding area. The primary disadvantages of this technology are the moderate initial cost, the potentially longer period of cleanup time required, and the need to monitor the aquifer geochemistry to ensure that conditions remain conducive for reductive dechlorination. In-Situ bioremediation with CAP18™ followed by MNA was considered to be the most viable combined technology for this Site and is discussed further in **Section 3.2**.

For any of the remedial alternatives considered above, control of indoor air vapors during remediation was considered necessary at the Plaza. As such, various sub-slab depressurization units commonly used for radon mitigation were considered to actively reduce indoor air intrusion. Three configurations were considered for establishing suction points beneath the subslab: exterior installation with multiple suction points horizontally through foundation wall, and two configurations using pipes inserted down through the slab from indoors. Advantages to these types of systems are that they are generally effective, require little maintenance, and are low cost. The only disadvantage is that there is a relatively short life span for the blower units (approximately 2 to 4 years), which would require some additional cost every few years as long as the units were needed. Given the ease of installation and overall effectiveness, this technology was considered to be the most viable technology to quickly mitigate indoor air concentrations at the Plaza during remediation. This is discussed further in **Section 3.2**.

### 3.2 SELECTED REMEDIATION TECHNOLOGY

MUNDELL has been in communication with IDEM throughout this project and performed further evaluation of site conditions and remedial approaches in the fall of 2006 through the spring of 2007. Technical feasibility and ease of implementation were considered key factors, since groundwater impacts observed were in areas close to Apartment dwellings and there are uncontrolled access areas near Michigan Street. In addition, mitigating potential human health risks associated with the impacts were also evaluated. This is discussed in further detail below.

### 3.2.1 Risk Assessment

There have been several assessment activities performed to investigate the potential risks that may be present from chemical release(s) at the Plaza. Several Indoor Air Studies have been conducted by MUNDELL at the Apartments and the Plaza (2002, 2003, 2004, and 2006), and throughout the course of these studies and the subsurface investigation work MUNDELL has conducted, the following exposure pathways have been evaluated:

#### 3.2.1.1 Ingestion Exposure Pathway


Although this is not currently a complete exposure pathway, since no nearby downgradient residential or industrial wells have been identified, it is considered a potential future complete pathway by IDEM, unless a permanent deed restriction or municipal ordinance is permanently put in place to prevent the consumption of groundwater as drinking water. The Site is located within one of seven MCHD NWZ Areas. As such, future permits for water supply wells will be reviewed and limited until identified impacted groundwater in the general area is remediated and groundwater quality is restored to a drinkable condition. Therefore, additional risk analyses were determined to be unnecessary, and were not performed for this Site for this exposure pathway.

#### 3.2.1.2 Dermal Exposure Pathway

This is not currently a complete exposure pathway in the Site conceptual model, as there is no ongoing direct contact with the soils or groundwater impacts, and PCE soil impacts detected are below those that would present a concern to construction workers should soils require excavation in the future. The surface water sampling performed in Little Eagle Creek at locations downgradient of the plume across Olin Avenue all showed no indication of chlorinated solvent impacts, so there is furthermore no direct exposure via surface waters. Lastly, IDEM has more recently agreed that for the indicator compounds under question for this Site, if dermal exposure were to occur, it would not present significant risk given the rapid volatilization of these chemicals. Therefore, additional risk analyses were not determined to be necessary, and were not performed for this Site for this exposure pathway.

#### 3.2.1.3 Inhalation Exposure Pathway

This is an identified human exposure pathway of concern, since concentrations of PCE and TCE have historically been detected in indoor air in the Plaza above current draft U.S. EPA guidance indicator indoor air concentration and IDEM draft default vapor intrusion concentrations. Data and evaluation of these indoor air concentrations was provided in the *Further Site Characterization Report* (MUNDELL, 2006b), and has been updated with risk computations, which are summarized in **Appendix E**. Toxicity



Characteristics for the indicator compounds are provided in **Table 16**. Remediation of this exposure pathway is further discussed in **Section 3.2.2**.

### 3.2.2 Remediation System Selection Factors


As a preventative measure and at the request of IDEM, AIMCO authorized the installment of four sub-slab air mitigation systems at the Plaza building, which have been actively applying a negative pressure to the sub-slab space beneath the unit formerly occupied by Accent Cleaners - Zacatecas (Unit 3819), as well as three other units – Village Pantry (Unit 3801), former Handicap Workshop (Unit 3815) and the Laundry (Unit 3823). PCE concentrations have been documented in the removal of vapors from these sub-slab areas, the highest of which have been from Unit 3819. More details on these systems are given in **Section 3.2.3.1**.

Given the reduction of risk from indoor air vapors accomplished with the current mitigation systems in place, the approach of substrate injection is more appropriate as an alternative corrective action method for the treatment of each of the source area plumes described in **Section 2.3** since there are no other current exposure risks from the site impacts. An in depth cost benefit analyses was performed of each viable option to further consider these alternative, the details of which are presented below.

#### 3.2.2.1 Remediation System Cost Analyses

A cost analyses summary of both remediation methods (active SVE-AS system and substrate injection using CAP18<sup>TM</sup>) were performed, the results of which were discussed with IDEM and are provided in **Appendix F**. **Figure 38** shows the conceptual layout of an SVE-AS system, as compared with the initial considerations of substrate injection locations and monitoring wells. The economic analyses showed that performing injection remediation first and evaluating its effectiveness in the first year was a conservative approach that could potentially mitigate chemical impacts. It also showed that there was no real economic disadvantage to waiting one to two years to install an active SVE/AS System as an addition to the injection, should it be needed.

To more accurately compare the groundwater cleanup scenarios discussed with IDEM on October 17, 2006, MUNDELL performed an engineering economic analyses on each of the three cleanup options (designated "Tiers"); Tier I represented remediation using chemical injection alone, Tier II represented chemical injection and one soil vapor extraction (SVE) and air sparging (AS) system, and Tier III represented chemical injection and two SVE and AS systems (to address multiple source areas). For each of these scenarios, all project costs (i.e., single year capital costs of remediation, repeating annual monitoring, operation and maintenance or project management costs, etc.) were laid out over a presumed cleanup period and then brought back to a present value (PV) cost using an interest rate of 5% and standard present value calculations. In this context, value represents a cost, therefore the lower the PV, the less money is spent. Alternative Scenarios (Tier IB, Tier IIB and Tier IIIB) were also evaluated to compare PV costs if additional injection rounds were needed (Tier IB), or if it might be beneficial to wait on installing a remediation system(s) during



the first year to evaluate the Site's response to chemical injection alone (as would be represented by Tiers IIB and IIIB). Iterations were calculated for presumed cleanup periods of 3, 5, 7, 10, 12 and 15 years for each of the Tiers, all of which are depicted on the attached Present Value Computation Sheets along with their assumptions.

The attached Cost Comparison Summary depicts the previously estimated ranges of costs for each Tier for 3, 5 and 7 year cleanup estimations, a Projected (non-Present Value) Cost Summary and a Present Value Calculations Summary, both summarizing total project costs for cleanup periods ranging from 3-15 years. Included in the Summary is a graph plotting each Tier's PV versus the anticipated number of years to cleanup the Site for a cleanup scenario. As can be seen on this graph, both of the PVs of Tier I (Injection Alone) are considerably less than the PVs of Tiers II and Tier III.

If it could be determined within the first year that chemical injection remediation (with one or multiple injections) can be completed in less than 8 years, these costs are likely to be considerably less than what would be spent in even the best case scenario of Tier II or Tier III, given an estimated cleanup time for SVE and AS systems would be at best 3 years, is typically 5 years, but may even be as high as 7 years.

#### **3.2.2.2 Remediation System Practical Design Considerations**

The injection of CAP18<sup>TM</sup> bioremediation product into contaminated areas in order to increase the productivity of the natural attenuation of impacted groundwater at the Site provides a non-disruptive, cost-effective means of protecting human health and the environment. As CAP18<sup>TM</sup> dissolves in groundwater, the triacylglycerols that compose the oil, hydrolyze into glycerol and fatty acids. Then, the native bacteria in the soil break down the C18 unsaturated fatty acids into acetic acid and hydrogen ions through a process known as beta-oxidation. The extra hydrogen ions produced through this reaction increase the ability of the environment to naturally attenuate the contamination through reductive dechlorination. In-situ types of remediation technology are appealing in general because they eliminate human exposure to contamination and containment issues ensuing from transport, and they minimize disruption to Site activities.

The CAP18<sup>TM</sup> bioremediation product is appealing for several reasons as well. The primary reason is because of its effectiveness and longevity in comparison to other bioremediation products. Whereas other food-grade bioremediation catalysts such as molasses or whey last less than 1 month, CAP18<sup>TM</sup> has been proven to work for periods of 1 year, and in some groundwater environments, as long as 5 years. As such, its treatment capacity is much greater per pound of product than other catalysts. In addition, due to the low viscosity of CAP18<sup>TM</sup>, high pressure pumping is unnecessary, thus allowing for a greater distribution of the product in the subsurface at reasonable injection pressures. This factor allows a wider spacing of injection points for the same treatment effectiveness and the use of standard direct push injection methods (*i.e.*, the use of a Geoprobe) for implementation of the approach.



### 3.2.2.3 Geochemical Treatability Study Prior to CAP18™ Injections

To evaluate the suitability of the aquifer environment to continue to support future natural attenuation enhanced by the injection of CAP18™, the geochemical parameters of the groundwater at the Site were evaluated during the monitoring event at the Meadows Apartments on October 22, 2004, with additional monitoring performed for the Plaza site in each of the Source Areas during the April 10, 2007 event (See **Table 17** and **Table 18**). The results of the sampling events indicated limited evidence of conditions that are naturally conducive to natural attenuation in the Source Areas. Dissolved oxygen (DO) concentrations in all of the Source Area wells monitored were above 2 mg/L, ORP values for all but one well were above 200 mV, and several of the locations had nitrate and sulfate concentrations large enough that there would be a reasonable amount of competition for reductive chlorination. The relatively lower ORP (-2 mV), DO (2.3 mg/L) and nitrate (<0.1 mg/L) however, showed strong evidence for anaerobic dechlorination potential in this area. As part of the consideration of this technology, the concept of driving the aquifer to an anaerobic condition by the injection of CAP18™ was considered to be theoretically viable. By taking away the available oxygen and making the hydrogen ions available, the PCE and TCE are able to breakdown under an anaerobic process, and the daughter products may continue to break down, or once the aquifer returns to an aerobic state, the aerobic degradation of those compounds may more naturally occur.

### 3.2.3 Selected Remediation Technologies

Based upon the 1) the extent and severity of the indicator compound concentrations, 2) site-specific operational constraints and uses, 3) geochemical and physical characteristics of the aquifer, and 4) economic factors, **In-Situ Bioremediation with CAP18™** followed by MNA is the selected remediation technology for the Site for treating groundwater. However, during the remedial process, if sufficient progress is not being made toward reaching acceptable closure levels, the addition of AS/SVE treatment systems in the *Source Areas* will be considered. During the remedial process, sub-slab air mitigation units have been chosen to control and prevent the inhalation exposure pathway due to indoor air concentrations.

The use of In-Situ Bioremediation with CAP18™ initially, in combination with AS/SVE if it becomes necessary during remediation to address the site indicator compounds was verbally approved by IDEM during a final conceptual meeting on May 25, 2007. Because much of the shallow soil impacts were determined to be less than the IDEM RISC commercial/industrial default closure levels (except for soils tested below the top of the groundwater table), no active soil remediation is being currently proposed as there will be a monitoring of the CAP18™ application to see its remedial effects. The following sections describe the remediation methods chosen and thus far implemented.

### 3.3 INDOOR AIR MITIGATION SYSTEM DESIGN AND IMPLEMENTATION

MUNDELL installed an indoor air mitigation system at the Plaza in September 2006 per its own evaluation and IDEM's recommendation. The goal of this system was to apply a vacuum on the sub-floor slab air environment and discharge the collected air to safe outside locations, thus alleviating the indoor air quality concerns from subsurface chemical impacts at the Michigan Plaza.

#### 3.3.1 Indoor Air Mitigation System Design

MUNDELL assessed various types of sub-slab depressurization unit, from various companies, with various installation applications (schematics for which are provided in **Appendix E**). Ultimately a centrifugal in line regenerative blower (RP-145 series), with design specifications indicating a range of 73 to 173 cubic feet per minute (cfm) was chosen to effectively capture vapors from underneath the plaza building.

#### 3.3.2 Indoor Air Mitigation System Installation


Four sub-floor slab depressurization units were installed by *Air Quality Control (AQC)* under the oversight of MUNDELL from September 14 to 21, 2006. A unit/blower was installed in the following spaces at Michigan Plaza: 1) Village Pantry (B-1), 2) Former Handicap Space (B-2), 3) Mexican Store (B-3), and 4) Laundromat (B-4). The system locations are illustrated in **Figure 39**. The system installation involved coring through the slab in each of the four spaces with a 'Bosch' hammer drill (see **Appendix E: Photo 2**). A 'vapor collection chamber' (see **Appendix E: Photo 1**) was created beneath the concrete floors at pre-selected locations. It was confirmed that there was porous material (pea-gravel) in the vicinity of the collection chamber in order to achieve maximum suction of the sub-slab vapors (see **Appendix E: Photo 3**).

Plastic vent pipes were installed into the collection chambers and the suction points were sealed in place in the concrete floor (see **Appendix E: Photo 5**). Primary suction pipes ran from the collection chambers to the nearest outside wall. The blowers were installed on the exterior and the exhaust pipe was continued to the roofline (safe discharge locations) (see **Appendix E: Photos 6 & 10**).

Differential pressure gauges were installed on pipes to monitor/display fan vacuum pressures (see **Appendix E: Photos 4 & 11**). Individual power circuits were installed to supply power for each of the blowers. Sampling ports were also installed onto the suction pipes to enable monitoring and the collection of system samples in the future. All four of the units were tuned up and began full-time operation on September 21<sup>st</sup> 2006.

#### 3.3.3 Indoor Air Quality Testing


A follow-up indoor air sampling event to evaluate post-installation mitigation system effectiveness was conducted by MUNDELL in October 2006. This event included sampling of the four units with the installed air mitigation systems at the Plaza. This event was performed after the systems had been running for about three weeks.



Indoor air samples were collected at four tenant units (Village Pantry (3801), vacant space (3815), Mexican Grocery store (3819) and the Laundromat (3823)) with the air mitigation systems. Each air sample was collected in a six-liter, evacuated, stainless steel Summa Canister equipped with a passive flow controller set to fill the canister over a 24-hour period. The air slowly filled the evacuated canister through a precision sapphire orifice, which was preset by DataChem Laboratories in Salt Lake City, Utah. Approximately 24 hours after each sample was placed in each building, the canisters were closed. Each of the air quality canisters used consisted of a total volume of 400 milliliters of air collected.

The canisters were then shipped back to DataChem Laboratories for analysis by a gas chromatograph/mass spectrometer (GC/MS) for TCE, PCE, cis-1,2-DCE, and VC utilizing a modified U.S. EPA Method T0-15 for Single Ion Monitoring (SIM). SIM allows detection of very low (sub-part per billion) concentrations of indicator analytes.

The analytical results of the air quality sampling at the Site are summarized in **Table 19a**, **Table 19b** and **Figure 40**. The DataChem Laboratories sample analysis data sheets provided in **Appendix E**. These results of the sampling were compared with the existing draft IDEM April 2006 indoor air quality guidelines, U.S. EPA draft guidance indicator indoor air concentrations (U.S. EPA, November 20, 2002), U.S. EPA indicator ambient air levels (U.S. EPA, 2003-2004), and OSHA Permissible Exposure Limits (PELs) for industrial settings, provided in **Table 19c**.



As of the last Summa Canister testing in October, 2006, the air mitigation systems had reduced the indoor air concentrations by about 95 % of their previous concentrations and the indoor air concentrations met or were only slightly above IDEM new draft April 2006 commercial levels. Since that time, several grab samples have been collected from the discharge of each system, with concentrations generally decreasing through June, 2007. Quarterly sampling of these discharge points has continued to show decrease (as seen on Table A1 in **Appendix E**), so there are several indications the concentrations have been effectively reduced and the systems are effectively mitigating the inhalation exposure pathway at the Plaza building. An additional round of Summa Canister indoor air monitoring has been scheduled for March, 2008 to quantify the continued reductions with laboratory analytical testing inside the units.

### 3.3.4 Indoor Air Mitigation System Monitoring

As a means of System Operation and Maintenance, Photo Ionization Detector (PID) readings and system sample collection and analysis will be performed by MUNDELL on a quarterly basis in order to track the levels of chemical constituents being removed by the system. The static pressure readings will also be monitored as a part of the system operation and maintenance (O&M) in order to ensure optimal suction by the blowers.


### 3.4 CAP18™ BIOREMEDIATION DESIGN AND IMPLEMENTATION

#### 3.4.1 CAP18™ Design

The amount and distribution of CAP18™ needed for each *Source Area* was designed taking several factors into account as well as the practical experience of the manufacturers of CAP18™, DBI Remediation Products, Inc. (DBI). The amount of CAP18™ to inject into the chemical *Source Areas* was calculated using the *Reagent Estimation Software* provided by DBI. This software takes into account the treatment area volume (based on plume size) and the soil characteristics (type, bulk density, fraction of organic carbon, total and effective porosity, hydraulic gradient and conductivity). The spreadsheet then calculates the dissolved and sorbed contaminant demand, as well as the background demand from geochemical parameters (i.e., the site levels of dissolved oxygen, nitrate, manganese, iron, sulfate and hardness). All of these parameters then factor into the stoichiometric demand for hydrogen, and the corresponding amount of CAP18™ needed for a particular treatment area. Microbial degradation and design contingency factors of safety are considered as well in the calculations. For this site, a factor of safety of 3 was selected to allow for degradation and design uncertainties. Spreadsheet assumptions for the calculation of demand for CAP18™ for each *Source Area* are shown in **Appendix F**, along with product information. Computations estimated that approximately 15,000 lbs, 19,000 lbs, and 14,000 lbs of CAP18™ were needed for *Source Areas A, B and C*, respectively, based on the indicator compound concentrations from February 2007 and geochemistry parameters obtained in April 2007.

Several iterations of CAP18™ injection distribution were evaluated using the *Reagent Estimation Software* and considering Site physical features. The first consideration was to determine what type of application would best fit the plume's size and distribution in each *Source Area* given the geology, geochemistry and indicator compounds. The saturated zone within each *Source Area* has a poorly-graded, medium sand (SP) underlain by a well-graded, gravelly sand (SW). Conventional experience with CAP18™ in sands confirms that fatty acids that get broken down through beta-oxidation can travel distances as great as 75 to 100 ft from the place of injection, thereby allowing "treatment" to continue downgradient as the fatty acids migrate and continue to lend hydrogen atoms for reductive dechlorination. Given this geologic advantage and the plumes being situated as they are in relation to Michigan Street and the Plaza building, it was determined that a 'treatment curtain' design distribution would be effective.

The injection spacing for the selected design is largely determined by the aquifer's ability to receive the product. An injection spacing of 10 ft on centers is considered very effective for the sands encountered at the Site, with normal curtain 'rows' stacked two deep for each curtain area. Curtain areas were generally aligned along sewer location where impacts were noted, or perpendicular to either the plume or parallel with building walls that controlled injection accessibility. Injection points along each curtain row were spaced approximately 10 feet apart, with adjustments between rows to allow the most even distribution of vector lines downgradient from injection points. This configuration was designed to provide the most thorough coverage per *Source Area*. After the number of points was established per *Source Area*, the total oil demand for each *Source Area* was divided by the number of points. First iteration design




loading estimates with conceptual layout was drafted and discussed with IDEM during the May 25, 2007 meeting (see **Figure 41**). This design accounted for injecting the CAP18™ conservatively throughout a 30 feet thickness in the upper saturated zone at each injection point.

Some field design adjustments to the injection distribution were made as the injection applications began in *Source Area B* on August 2, 2007. These adjustments included:

- 1) Introduction of the CAP18™ into the aquifer at 3-foot depth intervals, rather than every foot as was originally proposed.
- 2) Injection of the CAP18™ throughout the sand and gravel aquifer down into the top of the underlying silty clay glacial till, which acts as a barrier to further vertical groundwater movement. This adjustment effectively increased the factor of safety in design as the thickness of treatment zone was reduced.
- 3) Injection of twice as much CAP18™ into the upper 10 ft of the saturated zone as compared to greater depths. This placed the product in the most impacted zone of the aquifer.
- 4) Larger volumes of CAP18™ were injected into the highest concentration areas of the indicator compounds compared to the plume perimeters. This allowed for a longer period of activity from the presence of CAP18™ and its fatty acids in those areas, increasing their effectiveness. Thus, larger masses of CAP18™ injection loading were distributed in the more central areas of each *Source Area* plume to ensure the most longstanding availability of hydrogen for reductive dechlorination. **Figure 42** shows the final pre-injection design layout and loading.

#### 3.4.2 Health and Safety



Prior to CAP18™ injections, MUNDELL prepared a Health and Safety Plan to ensure that activities for remediation would be conducted with industry standard safety measures, and that the surrounding public would not be threatened by any of the activities that occurred. A copy of this HASP is provided in **Appendix G**.

Prior to drilling, MUNDELL called Indiana Plant Protection Service (IUPPS) for utility locates in the specific areas being drilled. As a supplement to this utility locate, MUNDELL also utilized its own geophysics department to provide more in depth locates of utilities and obstructions. As such, many proposed locations were adjusted slightly. Of particular importance was the detection of a sewer manhole previously covered, but believed to be the source of periodic releases just north of Geoprobe Boring GP-07. Uncovering of this manhole provided more exact locations in which to inject CAP18™ so as to surround the invert of this manhole with injection substrate in the vadoze and saturated zones.

As an additional safety measure for the on-site storage of CAP18, a chain link fence was erected behind the Plaza to store totes of CAP18™ (2100 lbs net weight each). The first shipment of totes was delivered to the Site on July 31, 2007, and the fence area was locked overnight during the duration of CAP18™ injection applications.

### 3.4.3 CAP18™ Injection Application

CAP18™ Injection remediation activities began on August 1, 2007, with a safety meeting with representatives of MUNDELL, Midway Services Inc. (MIDWAY), and DBI. MIDWAY performed injection of CAP18™ using a truck-mounted Geoprobe Model 5410 drill rig. CAP18™ totes were moved around to injection locations using a fork lift, and safety barricades were erected with yellow caution tape around each drilling area to shield the general public from drilling activities. All members of the remediation activities wore bright vests and level D personal protection equipment.

CAP18™ was injected into each injection point using the following protocol:

- 1) At each injection point, the geoprobe would direct push the drill rods down to the bottom depth, which after the first five borings, was determined to be just into the lower clay till layer.
- 2) The total poundage of CAP18™ loading designed per boring was then confirmed at each location, and a conversion of 7.2 pounds per gallon was made to estimate the amount of gallons required. From this amount, the estimated amount of 3-foot lifts was calculated, with the bottom lift being just into the clay till, and the top lift being anywhere from 1-3 feet above the observed water table (to account for seasonal fluctuations).
- 3) A 5-gallon bucket was used to load the CAP18™ from the tote into a hopper to stage the CAP18™ prior to delivery into the borehole. Graduations were put on both the 5-gallon transfer bucket and the hopper so as to keep track of quantities.
- 4) CAP18™ was then pumped from the hopper using a geoprobe grout system (GS-1000 series), through tubing sealed and connected to the tooling rods down into the bottom of the drill rods, where it was slowly injected under pressure into the formation at the 3-foot lift intervals and loading requirements established above.

CAP18™ injection remediation activities continued in each area as designed through the month of August 2007. At the end of the program, there was a slight amount of CAP18™ remaining, so three additional injection points were added to *Source Area A* on September 4, 2007, in which approximately 396 lbs of CAP18™ was injected into each. After each boring was completed, it was filled with granular bentonite and capped with either topsoil if in grassy areas, or asphalt patch in the parking areas. Photographic documentation of these remediation activities is provided in **Appendix F**.

**Table 20** is provided which shows the summary of CAP18™ injection quantities for each injection point, and each source area. Locations of all injection points are shown on **Figure 43**, the final design layout and as-injected documentation of CAP18™ distribution. The contour of the clay till in areas of injection is illustrated on **Figure 44**. Approximately 14,200 lbs, 20,300 lbs, and 12,500 lbs of CAP18™ were injected during this application into *Source Areas A, B* and *C*, respectively.



### 3.5 POST REMEDIATION MONITORING COMPLETED

Since the injection application was completed in September, 2007, there have been two rounds of quarterly groundwater monitoring. Analytical Data for each event is provided in **Appendix H**.

#### 3.5.1 Groundwater Monitoring Post-Remediation – September 2007

Quarterly groundwater sampling was performed after injection activities on September 19 and September 20, 2007 for the 3<sup>rd</sup> Quarter 2007. A 'Sample Pro Portable MicroPurge Pump' was utilized for uniform low flow purging and sample collection. This microPurge pump uses a quick-change, one-piece bladder design. After obtaining depths to water levels, the twenty (20) quarterly monitoring wells were sampled from the middle of the screened intervals using the bladder pump connected to a Troll 9000 multi-parameter meter. Prior to sampling wells the geochemical parameters were monitored with the Troll 9000 through an inline flow cell until temperature, pH, conductivity, and oxidation reduction potential values stabilized. The pump was decontaminated between wells and the bladders were disposed of after sampling each well.

Groundwater samples were collected into three 40-milliliter glass sample vials containing the preservative hydrochloric acid (HCl). Groundwater sample vials were placed in a cooler containing ice. All water samples were delivered to Pace Analytical Services, Inc. (Pace) using the appropriate chain-of-custody protocol for laboratory tests. The samples were analyzed for VOCs via U.S. EPA SW-846 Method 8260. Pace laboratory certificates of analysis for the groundwater samples analyzed are presented in **Appendix H**. Results for this event are presented on **Figure 45** (potentiometric surface map), **Figure 46** (groundwater analytical results summary), and are summarized on **Table 13**.

#### 3.5.2 Soil Investigation During Sewer Tie-In Construction – October 2007

Confirmation of PCE impacts emanating from the sewer system were documented during the excavation activities that occurred during sewer tie-in activities on October 1, 2007, whereby a new sewer line was being connected to the existing manhole at the bend of the sewer line which travels from the south to the north side of Michigan Street. In this excavation, one soil sample was obtained from the backhoe bucket at a shallow depth (approximately 4 feet bgs) which contained 243 ug/kg PCE (above 2006 RISC Default Residential Cleanup Level for soil). One deeper soil sample was obtained with a stainless steel hand auger immediately adjacent and below the invert of this manhole (approximately 9 feet bgs). This sample contained a PCE concentration of 2,300 ug/kg (above the 2006 RISC Default Commercial/Industrial Cleanup Level for soil). None of these deeper soils aside from the sample were removed as the utilities surrounding the manhole prohibited such activity. Analytical results are summarized in **Table 14**, illustrated on **Figure 35**, and the complete laboratory report is provided in **Appendix H**.

#### 3.5.3 Groundwater Monitoring Post-Remediation – December 2007

Quarterly groundwater sampling was performed after injection activities on September 19 and December 12-14, 2007 for the 4<sup>th</sup> Quarter 2007. After obtaining depths to water levels, the

twenty (20) quarterly monitoring wells were sampled using the Sample Pro Portable MicroPurge Pump was utilized for uniform low flow purging, and the Troll 9000 multi-parameter meter was used to monitor geochemical parameters prior to sample collection. The pump was decontaminated between wells and the bladders were disposed off after sampling each well. Groundwater samples were collected using the same protocol described above, and were delivered to Pace using the appropriate chain-of-custody protocol for laboratory tests. The samples were analyzed for VOCs via U.S. EPA SW-846 Method 8260. Pace laboratory certificates of analysis for the groundwater samples analyzed are presented in **Appendix H**. Results for this event are presented on **Figure 47** (potentiometric surface map) and **Figure 48** (groundwater analytical results summary), and are summarized on **Table 13**.

Preliminary results after two quarters of post-injection monitoring indicate reductive dechlorination has started in *Source Area B*. Results in *Source Area A* and *Source Area C* are showing a decline in concentrations, but not to the degree yet that confirms reductive dechlorination is occurring. Discussions with DBI affirm that it is typical that a few quarters of post-injection may pass before signs of dechlorination become evident. The results in *Source Area B* are therefore encouraging, and the other two areas (*Source Area A* and *Source Area C*) are expected to begin showing dechlorination signs within the next couple of quarters. Ongoing monitoring will continue to observe the progress as is described further below.

### 3.6 REMAINING INVESTIGATION AND REMEDIATION TASKS

There are some additional investigatory activities that have been discussed with IDEM, and some remaining remediation tasks MUNDELL is proposing to mitigate indoor air vapors in select Apartment buildings. The following sections describe the proposed activities.

#### 3.6.1 Additional Monitoring Well Installation in Cemetery Parking Lot Area

MUNDELL has made several attempts to obtain access to the Floral Park Cemetery property south of Michigan Plaza for soil and groundwater sampling purposes, all of which to date have not been successful. In the May 27, 2007 correspondence to IDEM, MUNDELL communicated that Floral Park Cemetery representatives have verbally communicated that access will be granted in 2008 to install one monitoring well. MUNDELL proposes limited soil and groundwater testing in the locations shown on **Figure 49** to assess conditions downgradient of *Source Area A* and be able to monitor conditions of the CAP18<sup>TM</sup> remediation. These locations were chosen based on distance from *Source Area A*, and some newly developed site features of that area which is now a paved parking lot with a retention pond that since its development, has always been empty each time MUNDELL was on Site. These activities will be documented with results in the quarterly reporting period in which they occur (see **Section 3.8.3**).



### 3.6.2 Additional Indoor Air Mitigation Systems at Apartments

The testing results from previous indoor air evaluations at the Michigan Meadows Apartments (MUNDELL 2002a, 2003b, 2004a) were determined by IDEM and the Marion County Health Department to not indicate any short-term health concerns for residents. As an added precaution during the remediation of groundwater impacts in the southern portion of the Apartments property, and based on long-term risk calculations that have been performed (provided in **Appendix E**), MUNDELL proposes the installation of three additional sub-floor slab depressurization units as Air Mitigation Systems, similar to the systems installed and currently active at the Michigan Plaza. These units will be installed to introduce the active control of vapors at Apartments Building Nos. 1, 6 and 10, in the general locations identified on **Figure 49**. These buildings were chosen as they have exhibited slightly elevated indoor air vapors historically, and they are the buildings most adjacent to the PCE groundwater plumes identified and currently being remediated in *Source Area B* and *Source Area C*. Monitoring of these systems will occur immediately and follow-up indoor air sampling will occur shortly thereafter, as discussed further in **Section 3.8.3**. These activities will be documented with results in the quarterly reporting period in which they occur (see **Section 3.8.3**).

## 3.7 COMMUNITY RELATIONS PLAN

AIMCO and MUNDELL have managed site investigation and remediation activities with ongoing communication to the residents, tenants and adjacent property owners consistently throughout the project. Pursuant to Indiana Code (IC) 13-25-7, a Community Relations Plan has been formally prepared in accordance with the Indiana Department of Environmental Management's (IDEM) Office of Land Quality nonrule policy document Waste-0049-NPD. The purpose of the plan is to ensure the surrounding community will continue to be made aware of the history, status of the project, and remediation activities at the above-referenced Site so that there continues to be community participation and attentive response to public questions. The plan documents community relations that have been completed to date and outlines additional steps to update and enhance such communication such that the ultimate goal of protecting human health and environmental quality is met and understood. A copy of this community relations plan is provided in **Appendix I**.

## 3.8 MONITORING AND SAMPLING PLAN

A monitoring and sampling plan has been established for the groundwater monitoring and indoor air monitoring to track progress of the remediation. The Quality Assurance Project Plan (QAPP) for this project was provided in the *Further Site Characterization Report* (MUNDELL, 2006b), therefore no additional submission is required by the RISC technical guide. These monitoring and sampling activities are proposed, and are subject to change based on IDEM's review and site conditions.

### 3.8.1 Groundwater Monitoring Program

Groundwater monitoring activities will consist of quarterly groundwater sampling of the existing twenty (20) monitoring wells established with IDEM on May 25, 2007, with the addition of at least one more monitoring well in the Floral Park Cemetery property, for a total of twenty-one (21) groundwater monitoring wells sampled on a quarterly basis. The following constitute this quarterly groundwater monitoring network:

- 1) *Nineteen MUNDELL monitoring wells:* MMW-1S, MMW-8S, MMW-9S, MMW-10S, MMW-P-01, MMW-P-02, MMW-P-03S, MMW-P-03D, MMW-P-04, MMW-P-05, MMW-P-06, MMW-P-07, MMW-P-08, MMW-P-09, MMW-11S, MMW-P-10S, MMW-P-10D, and MMW-P-09D and proposed MMW-P-11, and
- 2) *Two (2) Keramida monitoring wells:* MW-168S and MW-168D.

In addition to collection of groundwater levels from each of these monitoring wells, MUNDELL will measure groundwater levels from four nests of Keramida monitoring wells surrounding the Plaza Property for the purpose of more accurately determining the groundwater flow direction and gradient over this wider area. The following additional wells will have their groundwater levels measured each quarter:

- 3) *Eight (8) Keramida monitoring wells:* MW-167S, MW-167D, MW-169S, MW-169D, MW-170S, MW-170D, MW-171S and MW-171D.

For at least the next two years post-injection period, groundwater samples will be submitted to Pace Analytical Laboratories for VOC analysis via U.S. EPA SW-846 Method 8260, along with appropriate duplicate (DUP), matrix spike (MS) and matrix spike duplicate (MSD). Baseline groundwater geochemical parameters (pH, dissolved oxygen, oxidation-reduction potential, conductivity, and temperature) will be measured with a low-flow cell and multi-parameter water quality probe throughout the first two years of the post-injection period to evaluate whether aquifer conditions continue to be favorable for natural attenuation of the indicator compounds at the Site. Additional geochemical parameters (nitrate, sulfate, ferrous iron) will be performed quarterly during the first year post-injection period in a minimum of three monitoring wells per *Source Area* so as to obtain data inside and outside the aquifer treatment zone. Nitrate analyses will be performed by Colormetric Method 352.1, and Sulfate Analyses will be performed by EPA U.S. SW 846 Method 9038, both by Pace. A field Colormetric Hach Method 8146 test kit will be used to collect ferrous iron (Iron II) readings during all sampling events, which will be compared with the total Iron results collected pre-injection in each *Source Area*.

Additional aquifer chemical parameter testing is planned to occur within the first year post-injection period, but will be scheduled based on observed response and development in each plume area. Additional aquifer parameters including methane, ethene, and ethane will be analyzed to evaluate indicator compound breakdown and redox-sensitivity. In addition, volatile fatty acids (VFA) be analyzed within the first year to evaluate substrate distribution and lifetime duration of the product. These samples will be collected in select monitoring wells representative of each plume within the next two quarters of 2008 to monitor the presence of

residual CAP 18<sup>TM</sup> in the aquifer and to provide additional monitoring of aquifer conditions. Future monitoring of these constituents will be performed as needed to evaluate the natural attenuation process.

In addition to the twenty-one (21) groundwater monitoring wells that are sampled on a quarterly basis, an additional fourteen (14) groundwater monitoring wells will be sampled on an annual basis, as established with IDEM on May 25, 2007 for the purpose of monitoring the wider surrounding aquifer conditions emanating from Genuine. The following lists these additional wells:

- 1) *Six MUNDELL monitoring wells:* MMW-2S, MMW-3S, MMW-4D, MMW-5D, MMW-6D, MMW-7S, and
- 2) *Eight (8) Keramida monitoring wells:* MW-167S, MW-167D, MW-169S, MW-169D, MW-170S, MW-170D, MW-171S and MW-171D.

A table listing the proposed monitoring and sampling program monitoring wells, analytical methods and frequency is included as **Table 21**, and is also illustrated in **Figure 50**.

### 3.8.2 Air Mitigation System Monitoring Program

As part of the continued Air Mitigation System Monitoring Program, MUNDELL will continue to monitor the discharge air at each of the units at the Plaza, both with a PID and analytical testing. These activities will also commence after the installation of the sub-floor slab depressurization units proposed in **Section 3.6.2**.

In addition to this quarterly sampling, another round of indoor air samples will be collected after each of the three Apartment units in which systems are being installed, along with samples from each of the four existing units in the Plaza. Four ambient air samples will be collected to allow for the assessment of background air quality in the area at the time of site closure. Each air sample will be collected in a six-liter, evacuated, stainless steel Summa Canister equipped with a passive flow controller set to fill the canister over a 24-hour period to collect an anticipated total volume of 400 milliliters of air per canister. The canisters will be shipped back to DataChem Laboratories for analysis by a gas chromatograph/mass spectrometer (GC/MS) for TCE, PCE, cis-1,2-DCE, and VC utilizing a modified U.S. EPA Method T0-15 for Single Ion Monitoring (SIM).

MUNDELL does not anticipate the need for further indoor air testing after this next event, but will continue monitoring the discharge air from each unit on a quarterly basis through the first year post-injection, at which time the program will be evaluated. If vapor concerns are not able to be permanently eliminated through the ongoing mitigation systems, and current groundwater remediation, some form of permanent engineering control may need to be established, but this is not anticipated.



### 3.8.3 Corrective Action Progress Reporting

Results of the each quarter's groundwater sampling and air monitoring data will be summarized in a quarterly remediation progress report for the quarter in which the monitoring is performed. As the groundwater monitoring program is continued, plume stability and projected time-to-cleanup analyses will be performed. Plume stability analyses will be performed using the Mann-Kendall trend test outlined in the Appendix 3 of the 2001 IDEM RISC Technical Guide. The need for additional remediation steps (if needed) will continue to be evaluated based on plume stability status, the trends in indicator compound concentrations and evaluation of groundwater geochemistry. A Site closure report will be submitted either when indicator compounds for the Site remain below the remedial objectives for eight (8) consecutive quarters, or at the conclusion of a full seven (7) year plume stability monitoring period.

### 3.9 PROJECTED WORK SCHEDULE

Quarterly sampling commenced during the first quarter of 2007 and is ongoing. The CAP18™ injection application occurred August 1, 2007 through September 4, 2007, with no further injections since, but two additional, post-injection monitoring events. The next "annual" groundwater sampling event is scheduled for the 2<sup>nd</sup> quarter of 2008. A final *Site Closure Report* is scheduled to be filed with IDEM no later than 2014, but may be realized earlier depending on remediation progress at the Site.

Remedial action at the Site will conclude with demonstration through confirmation sampling that 2006 RISC Default Commercial/Industrial Cleanup Levels have been achieved for indicator compounds in groundwater. Site closure with institutional controls will be pursued either when cleanup goals have been achieved and maintained for a two-year monitoring period, or when the plume is shown to be stable or decreasing after a full seven (7) year stability monitoring period. At the time of site closure, a certificate-of-completion (CoC) and a covenant-not-to-sue (CNTS) will be sought from IDEM and the Governor's Office of Indiana.

**Table 21** has been provided to communicate the anticipated schedule of groundwater monitoring, air monitoring and reporting requirements. The timeline offered in this table is proposed, and because it cannot yet be predicted how long remediation will be required, a definitive year of closure is only shown as an estimated value. The next year of testing and evaluation will help better determine the effectiveness of these remediation activities and any remaining activities warranted.

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Mundell & Associates, Inc., August 15c, 2007, *Quarterly Monitoring Progress Report, 2<sup>nd</sup> Quarter 2007 – Michigan Plaza, 3801-3823 West Michigan Street, Indianapolis, Indiana*.

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United States Department of the Interior, Geologic Survey, Topographical Map, Indiana Quadrangle, 1986.

## **FIGURES**



Source: Maywood, Indiana Quadrangle  
USGS 7.5 Minutes Series (Topographic)  
1986

0 1,000 2,000  
Scale in Feet



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Site Vicinity skd  
Date Prepared:  
5/15/03  
Scale:  
1"= 2,000 Feet

**SITE LOCATION**  
Michigan Plaza  
Remediation work Plan  
3801-3823 West Michigan Avenue  
Indianapolis, Indiana

**FIGURE**

**1**



# **LEGEND**

- Fence
- Kansas Monitoring Wells

Apartments, Plant Units, and Surrounding Properties are illustrated as they were first documented. Some of the surrounding properties have changed, and additional information will be presented on subsequent figures in the Remediation Work Plan.



SCALE  
0 100 200

East  
Kansas Monitoring Well Locations Referenced  
From Kansas Environmental, Inc.  
Project No. 2020  
March 11, 2002

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Project Number:  
M03046  
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Base Map SK2  
Date Prepared:  
7/3/07  
Scale:  
1"=200'

**Site Map**  
Michigan Plaza and Meadows Apartments  
Remediation Work Plan  
3801-3823 West Michigan Street  
Indianapolis, Indiana

**FIGURE**  
**2a**





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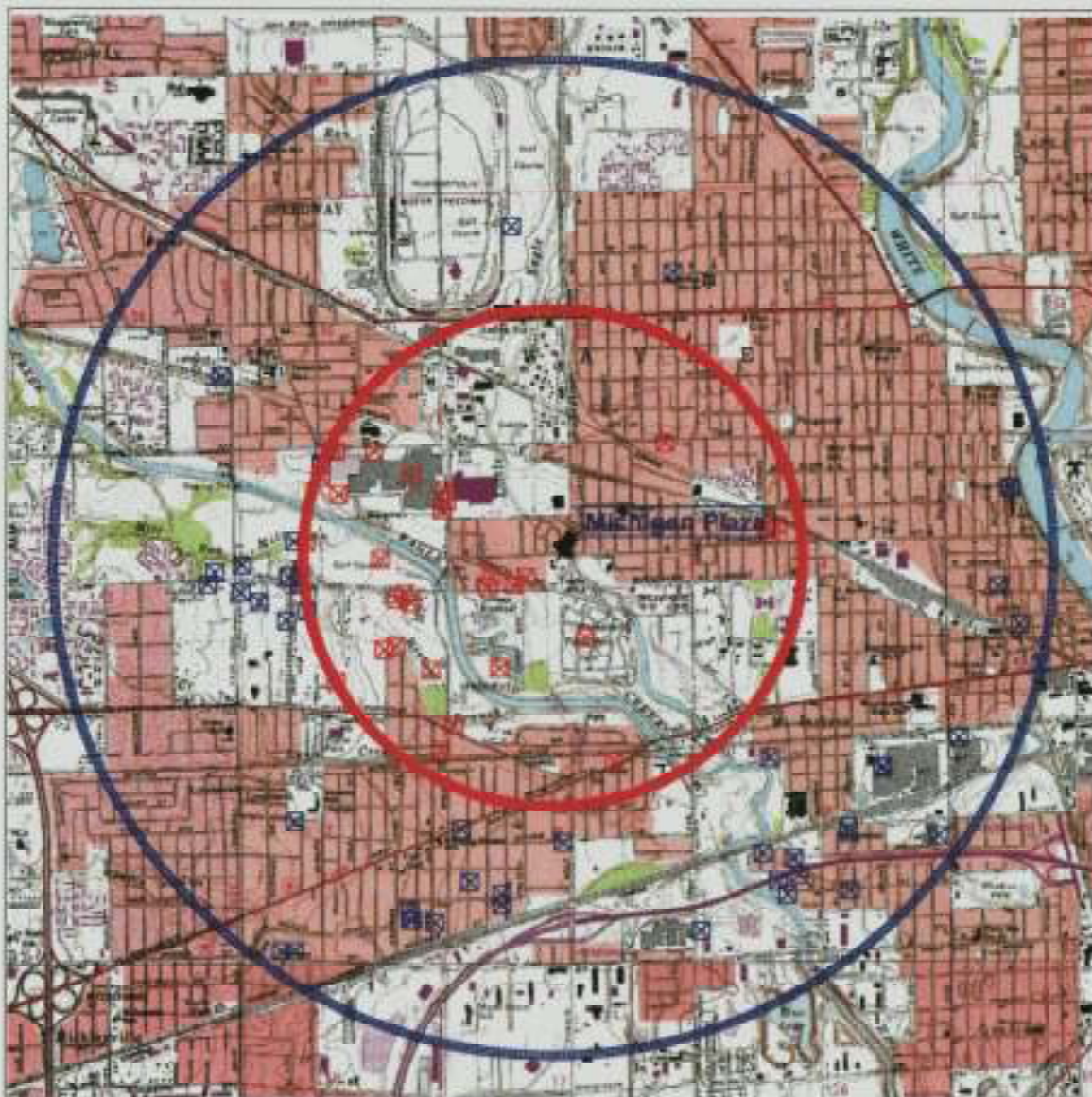
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Project Number:  
M01046  
Drawing File:  
Bawmng\_rev2  
Date Prepared:  
11/6/07  
Scale:  
1"=80'

**SITE MAP**  
Michigan Plaza  
Remediation Work Plan  
3801-3823 West Michigan Street  
Indianapolis, Indiana

**FIGURE**  
**2b**



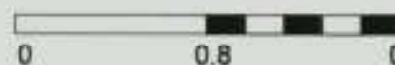
Source: Maywood, Indiana Quadrangle,  
USGS 7.5 Minutes Series (Topographic) 1986

☒ Low Capacity Water Well Within 1 Mile Radius of Site

☒ Low Capacity Water Well Within 2 Mile Radius of Site



MILES



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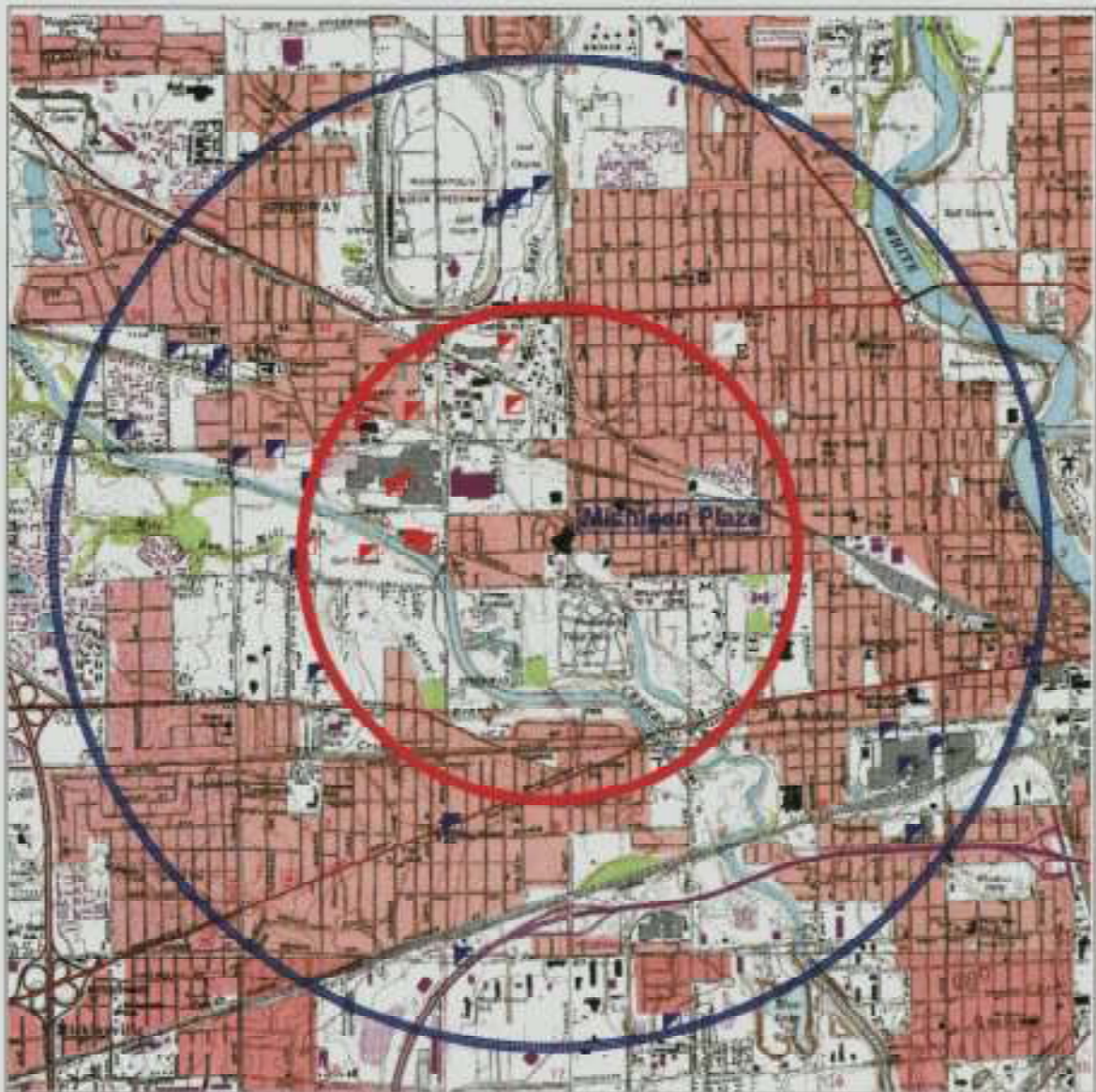
Project Number:  
M01046  
Drawing File:  
Figures.srf  
Date Prepared:  
01/31/06  
Scale:  
See Above

**AREA LOW CAPACITY WATER WELLS  
LOCATED WITHIN 1 and 2 MILE RADIUS**  
Remediation Work Plan  
Michigan Plaza  
3801-3823 W. Michigan Street  
Indianapolis, Indiana

FIGURE

**3a**

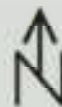




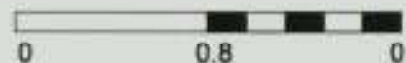
Source: Maywood, Indiana Quadrangle,  
USGS 7.5 Minutes Series (Topographic) 1986

■ High Capacity Water Well Within 1 Mile Radius of Site

■ High Capacity Water Well Within 2 Mile Radius of Site



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Project Number:  
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Drawing File:  
Figures.srf  
Date Prepared:  
01/31/06  
Scale:  
See Above

**AREA HIGH CAPACITY WATER WELLS  
LOCATED WITHIN 1 and 2 MILE RADIUS**

**Remediation Work Plan**

**Michigan Plaza**

3801-3823 W. Michigan Street  
Indianapolis, Indiana

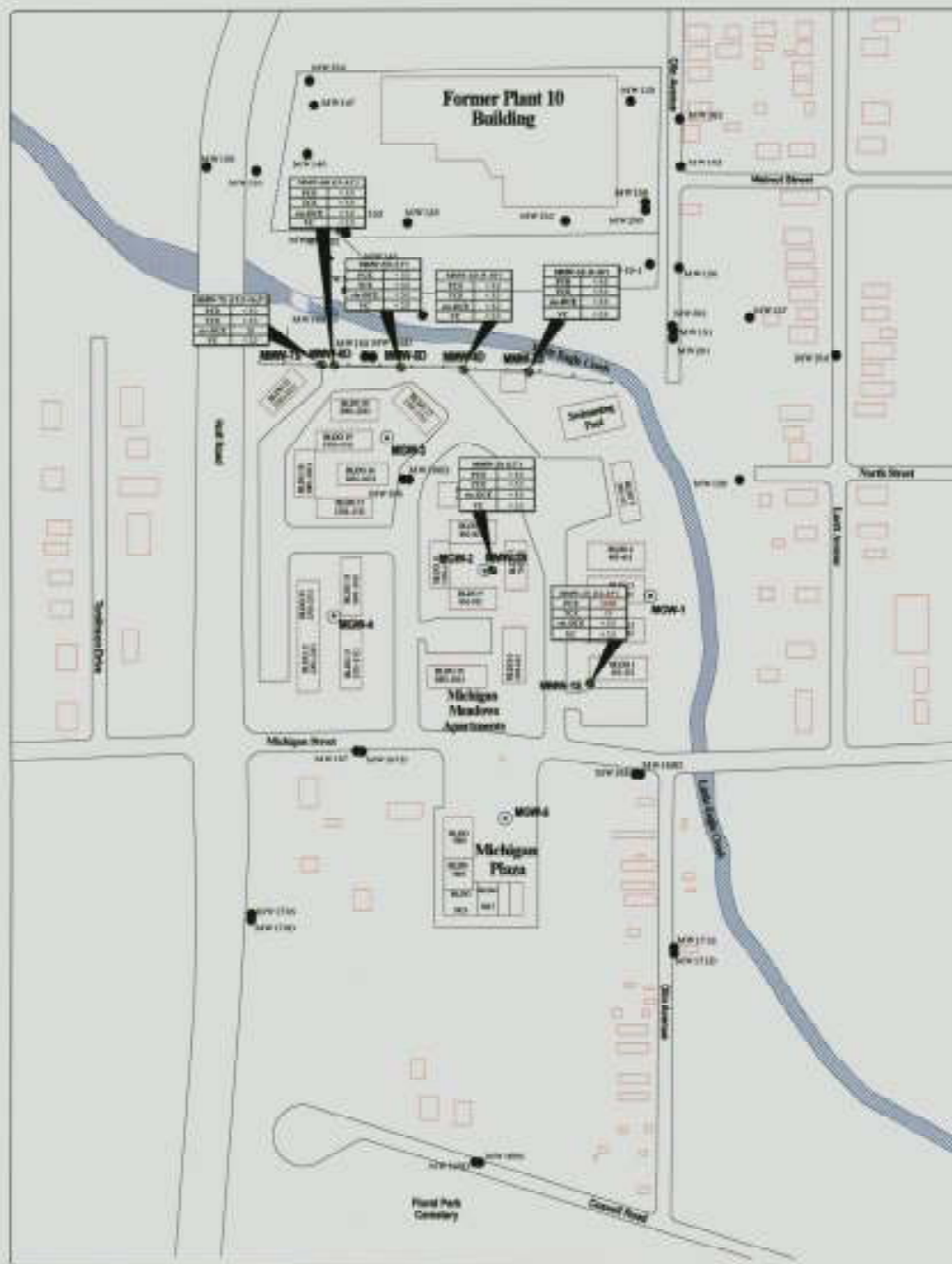
**FIGURE**

**3b**









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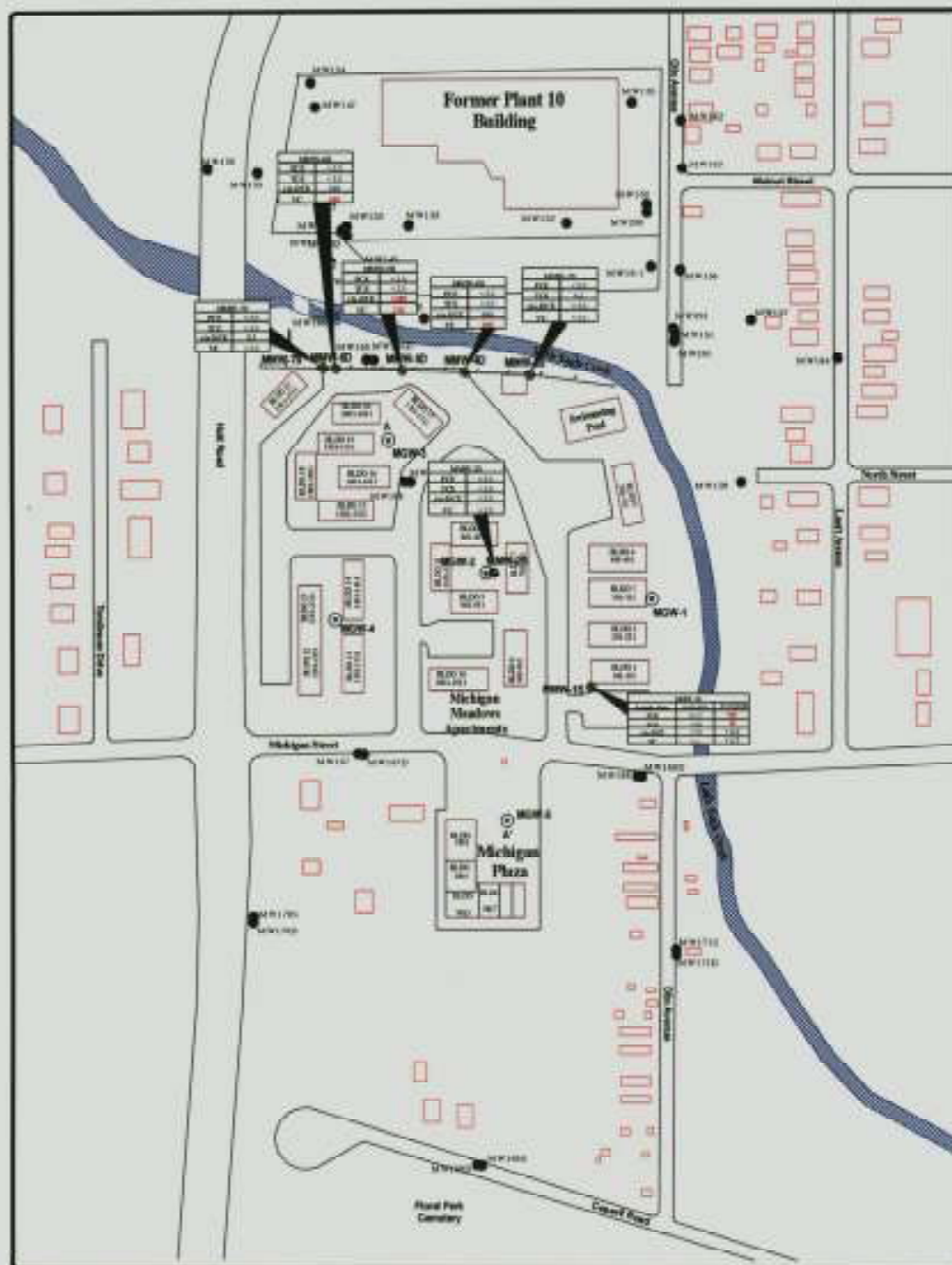
429 East Vermont Street, Suite 200  
Indianapolis, Indiana 46202-3668  
317-630-9060, fax 317-630-9065

Project Number:  
M01046  
Drawing File:  
Base Map/SKF  
Date Prepared:  
11/17/04  
Scale:  
1"=200'

**SOIL ANALYTICAL RESULTS**  
**Phase II Site Investigation**  
**Michigan Meadows Apartments**  
**3800 West Michigan Avenue**  
**Indianapolis, Indiana**

FIGURE

**6**



# LEGEND

- Fence
- MW 100 Karanda Monitoring Well
- MW 101 New MUNDELL Monitoring Well (August 2004)

Sample Location	
PCE	Tetrachloroethene (ug/L)
TCF	Trichloroethene (ug/L)
cis-DCE	cis-1,2-Dichloroethene (ug/L)
VC	Vinyl Chloride (ug/L)

Note: ND (Not Detected)



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MD1066  
Drawing File:  
Base Map SKG  
Date Prepared:  
11/17/04  
Scale:  
1"=200'

**GROUNDWATER ANALYTICAL RESULTS**  
**Phase II Site Investigation**  
Michigan Meadows Apartments  
3800 West Michigan Avenue  
Indianapolis, Indiana

FIGURE

**7**

# Michigan Meadows Apartments



0 30 60  
Scale: 1 inch = 60 feet

Residential Area

MICHIGAN STREET

GP-01 (15.5')	
PCE	< 5.0
TCE	< 5.0
cis-DCE	5.4
VC	< 2.0

GP-01

Michigan Plaza

Residential Area

GP-05 (17')	
PCE	< 5.0
TCE	< 5.0
cis-DCE	< 5.0
VC	< 2.0

GP-05

## LEGEND

- Approximate MUNDELL Geoprobe Locations (August 2004)
- Results in BLUE exceed IDEMRISC  
Default Residential Cleanup Level & in RED exceed  
IDEMRISC Default Nonresidential Cleanup  
Level

230

Boring ID (depth in feet)	
PCE	Tetrachloroethene (ug/kg)
TCE	Trichloroethene (ug/kg)
cis-DCE	cis-1,2-Dichloroethene (ug/kg)
VC	Vinyl Chloride (ug/kg)

GP-02 (7')	
PCE	35
TCE	< 5.0
cis-DCE	< 5.0
VC	< 2.0

GP-02

Residential Area

GP-03

GP-04

GP-04 (16')	
PCE	200
TCE	< 5.0
cis-DCE	< 5.0
VC	< 2.0

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REV	DATE	DESCRIPTION	BY	APPD

ANALYST	DATE	TIME

SOIL ANALYTICAL RESULTS  
MICHIGAN PLAZA  
Phase I Site Investigation  
Michigan Plaza  
300 N. 10th St. West  
Indianapolis, Indiana

FIGURE  
8



# Michigan Meadows Apartments



0 30 60  
Scale: 1 inch = 60 feet

## LEGEND

● Approximate MUNDALL Geoprobe Locations (August 2004)

230 Results in R.E.I.E. scored IDEM VRP Tier II Residential Cleanup Goal & in R.E.I.E. scored IDEM VRP Tier II Nonresidential Cleanup Goal

Boring ID (depth in feet)	
PCE	Tetrachloroethane (ug/l)
TCE	Trichloroethane (ug/l)
cis-DCE	cis-1,2-Dichloroethane (ug/l)
VC	Vinyl Chloride (ug/l)
TVOHs *	Total Volatile Organic Halides (ug/l)

GP-42-12'	
PCE	< 5.0
TCE	< 5.0
cis-DCE	34
VC	< 2.0
TVOHs *	19.4

GP-01	
PCE	21'
TCE	6.8
cis-DCE	120
VC	< 2.0
TVOHs *	105

GP-03	
PCE	7.30
TCE	< 5.0
cis-DCE	79
VC	< 2.0
TVOHs *	360

GP-05-22'	
PCE	< 5.0
TCE	< 5.0
cis-DCE	< 5.0
VC	< 2.0
TVOHs *	0

GP-04-22'	
PCE	2.3
TCE	< 5.0
cis-DCE	< 5.0
VC	< 2.0
TVOHs *	0

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THE RESULTS ARE AN INDICATION OF THE QUALITY OF THE DATA OBTAINED AND DO NOT GUARANTEE THE ACCURACY OF THE DATA. THE RESULTS ARE NOT TO BE USED FOR ANY PURPOSE OTHER THAN THAT FOR WHICH THEY WERE OBTAINED AND ARE NOT TO BE USED FOR ANY OTHER PURPOSE WITHOUT THE WRITTEN CONSENT OF MUNDALL & ASSOCIATES, INC.

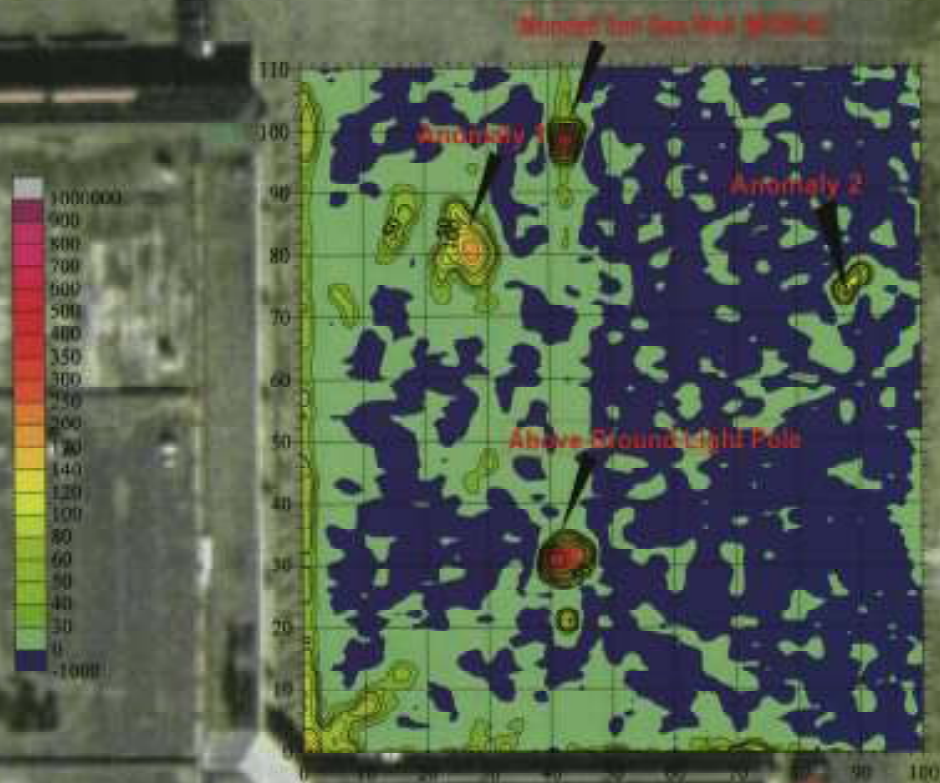
DATE	DEPTH	DESCRIPTION	BY	DATE

ANALYST	ANALYST DATE	ANALYST TIME

GROUNDWATER ANALYTICAL RESULTS  
MICHIGAN PLAZA  
Phase II Site Investigation  
Michigan Plaza  
3801-3815 West Michigan Street  
Indianapolis, Indiana

FIGURE  
9

# Channel Three



EM-61 Geophysical Survey Results, March 2005  
Mundell & Associates, Inc.

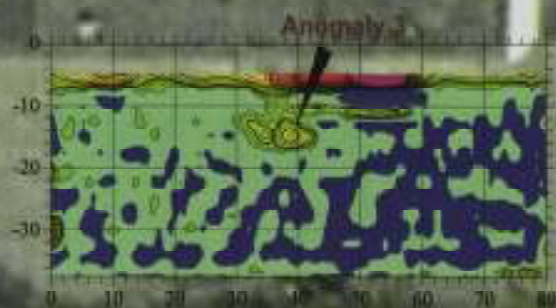
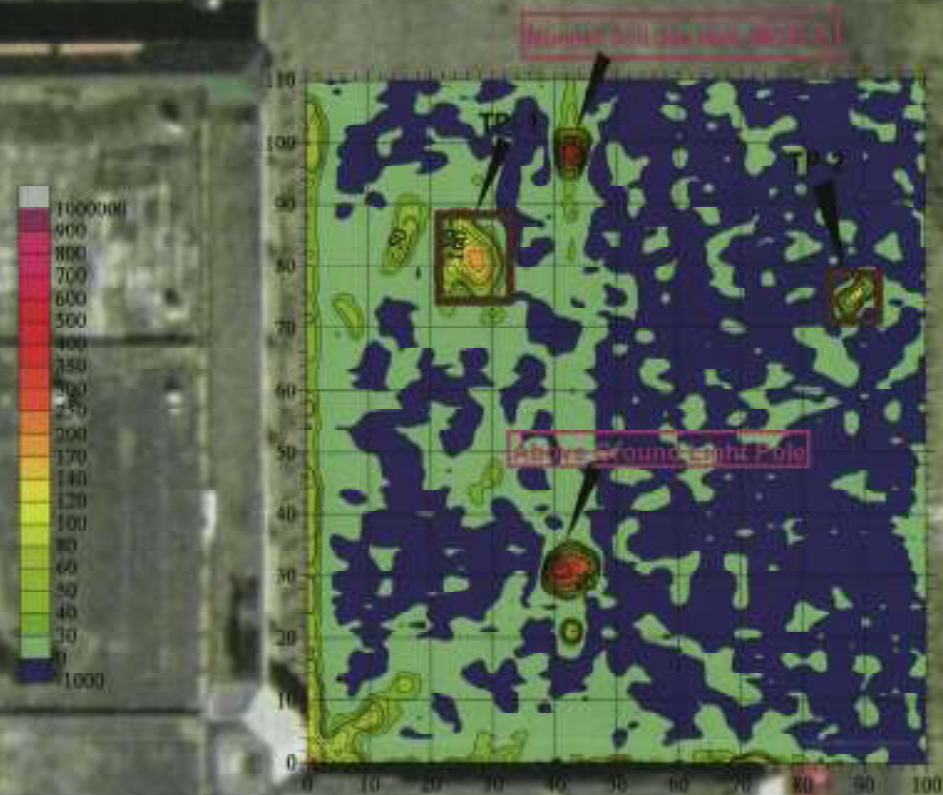


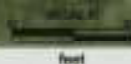
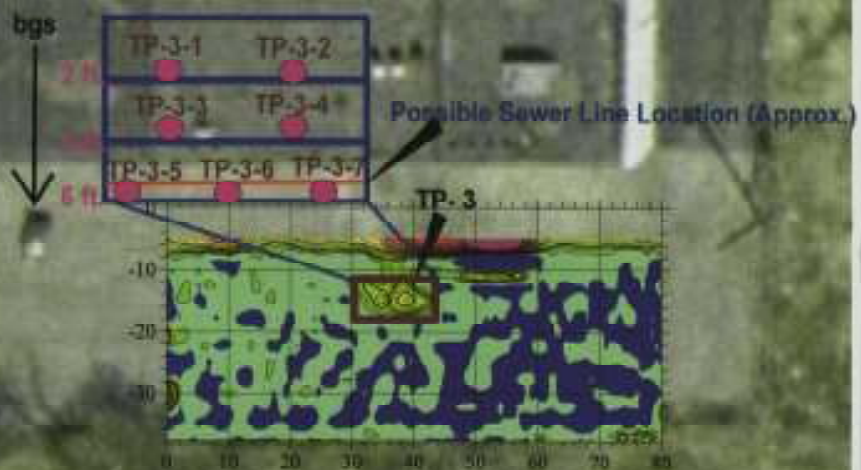
Figure 10: Geophysical Anomalies



# Channel Three



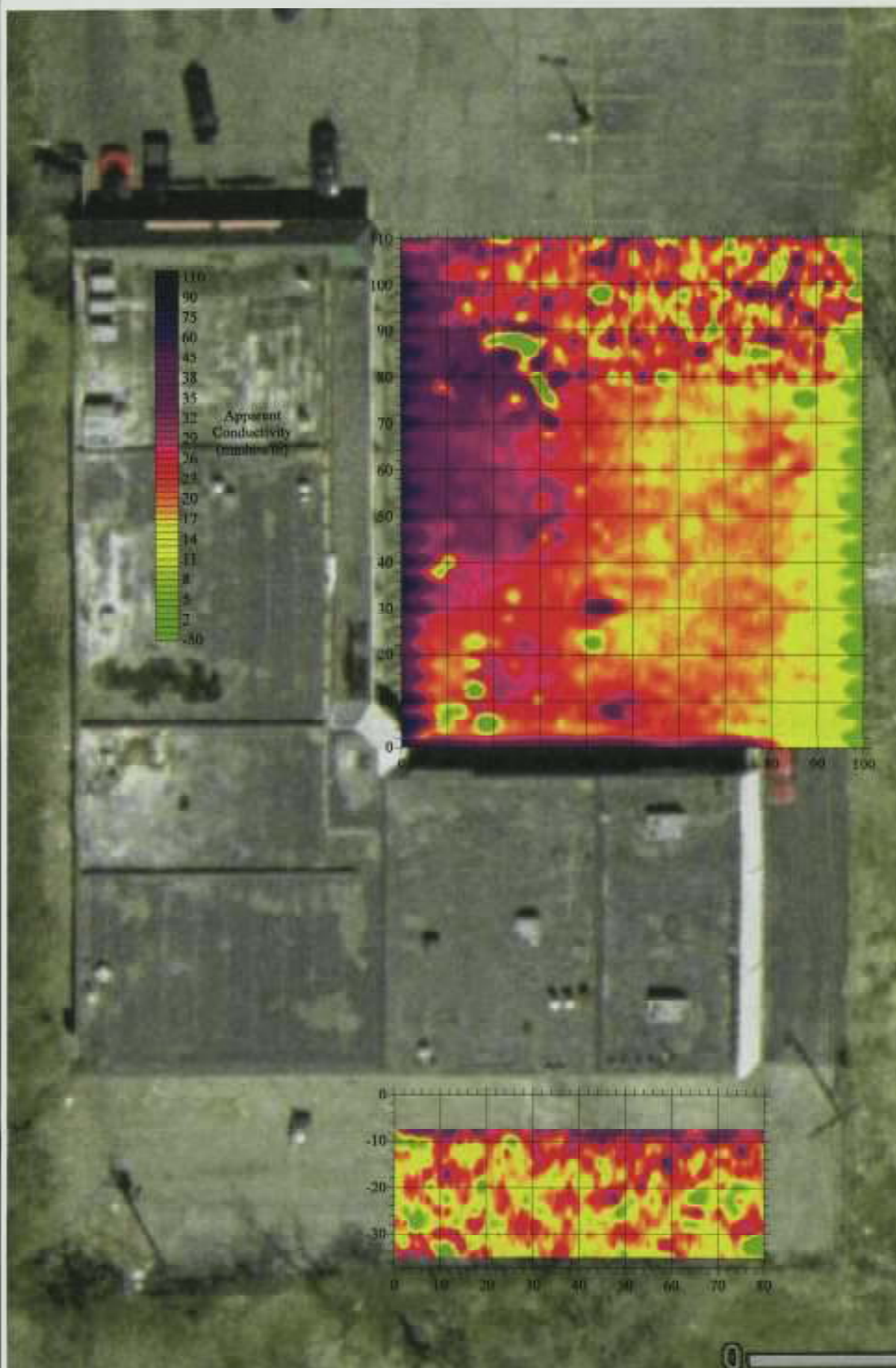
## NORTHERN WALL OF TP-3



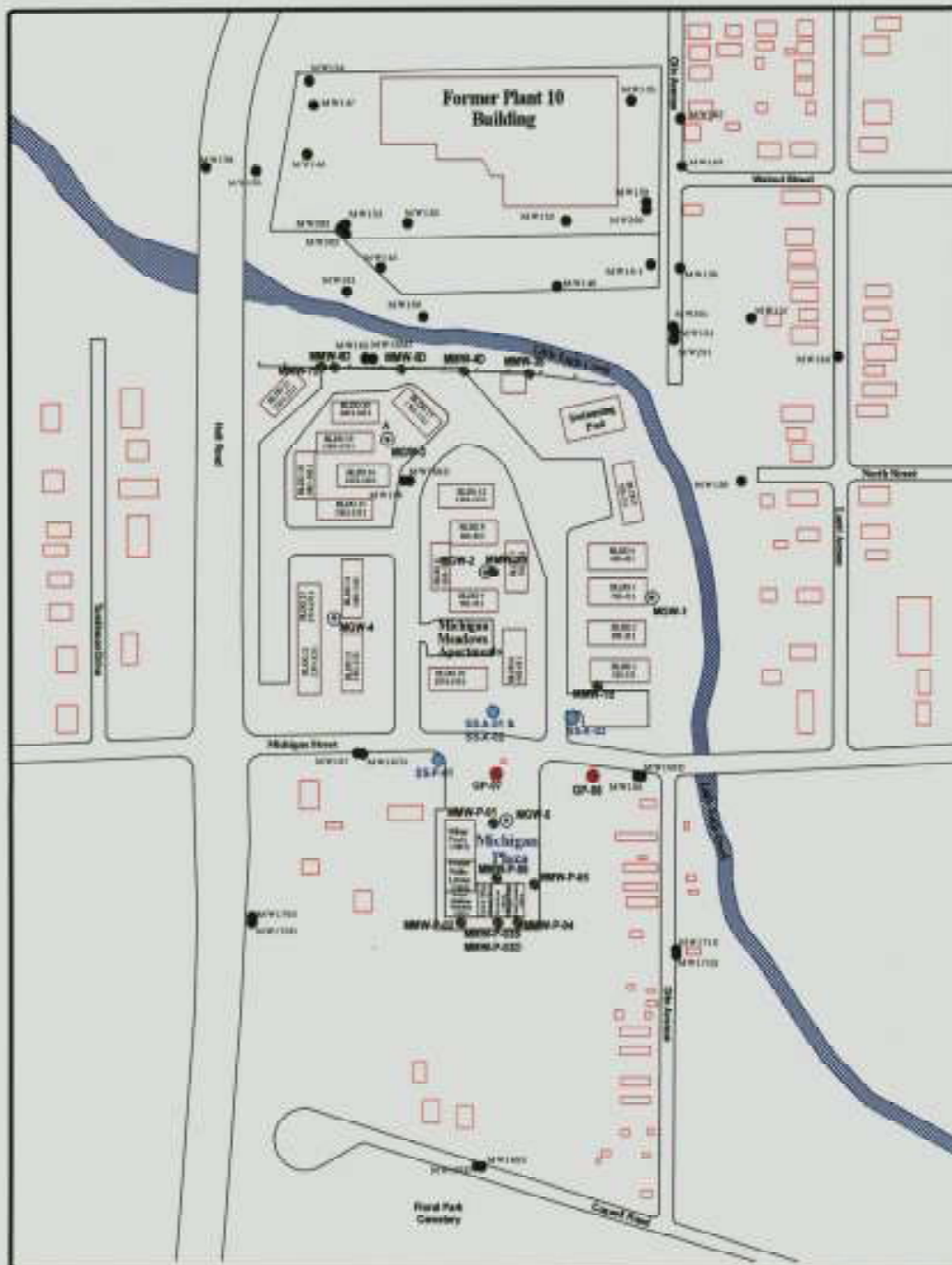
MUNDELL Project Number: M21045  
Client: AIMCO  
Project Name: Michigan Meadows  
Project Location: Indianapolis, IN

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Figure 11: Test Pit Locations







# LEGEND

- Fence
- Keweenaw Monitoring Wells
- MWN-P-01 MUNDELL Monitoring Wells (August 2004 (Apts) and September 2005 (Plaza))
- SS-P-01 MUNDELL Sewer Sampling Locations (September 2005)
- GP-P-01 MUNDELL Soil Boring Locations (September 2005)



SCALE  
0 2000  
feet  
Keweenaw Monitoring Wells Location Referenced  
From Keweenaw Environmental, Inc.  
Project No. 2021  
March 11, 2002

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M01046  
Drawing File:  
Site Map.SBT  
Date Prepared:  
1/10/05  
Scale:  
1"=200' ±

**SITE PLAN**  
**Further Site Characterization**  
**Michigan Apartments and Plaza**  
**3800-3823 West Michigan Avenue**  
**Indianapolis, Indiana**

**FIGURE**

**13**

# Michigan Meadows Apartments



0 30 60

Scale: 1 inch = 60 feet

SS-A-01 &  
SS-A-02

SS-A-03

SS-P-01

MICHIGAN STREET

Residential Area

MW-P-01  
MW-P-05

Michigan  
Plaza

GP-06  
MW-P-06

GP-06		
(B-10)	115-167	
PCE	< 5.0	< 5.0
TCE	< 5.0	< 5.0
vin-DCE	< 5.0	< 5.0
VC	< 2.0	< 2.0

Residential Area

MW-P-02 MW-P-03S MW-P-04  
MW-P-03D

Floral Park Cemetery Property

## LEGEND

GP-06/MW-P-06

MUNDELL Monitoring Well Locations (September 2002)

230

Results in BLUE exceed IDRM VSP Tier II  
Residential Cleanup Goal & in RED exceed  
IDRM VSP Tier II Nonresidential Cleanup  
Goal

Sewer Line Location

Monitoring Well Depth (in feet)	
PCE	Trichloroethylene (ug/kg)
TCE	Trichloroethylene (ug/kg)
vin-DCE	vin-Dichloroethylene (ug/kg)
VC	Vinyl Chloride (ug/kg)

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ANALYST	ANALYST ID	TEST NO.
COVENS	1-07	1-07-001
MUNDELL	11	11-001
MUNDELL	11	11-001
MUNDELL	11	11-001

SOIL ANALYTICAL RESULTS  
MICHIGAN PLAZA  
Further Site Characterization  
Michigan Plaza  
1801-1821 West Michigan Street  
Indianapolis, Indiana

FIGURE

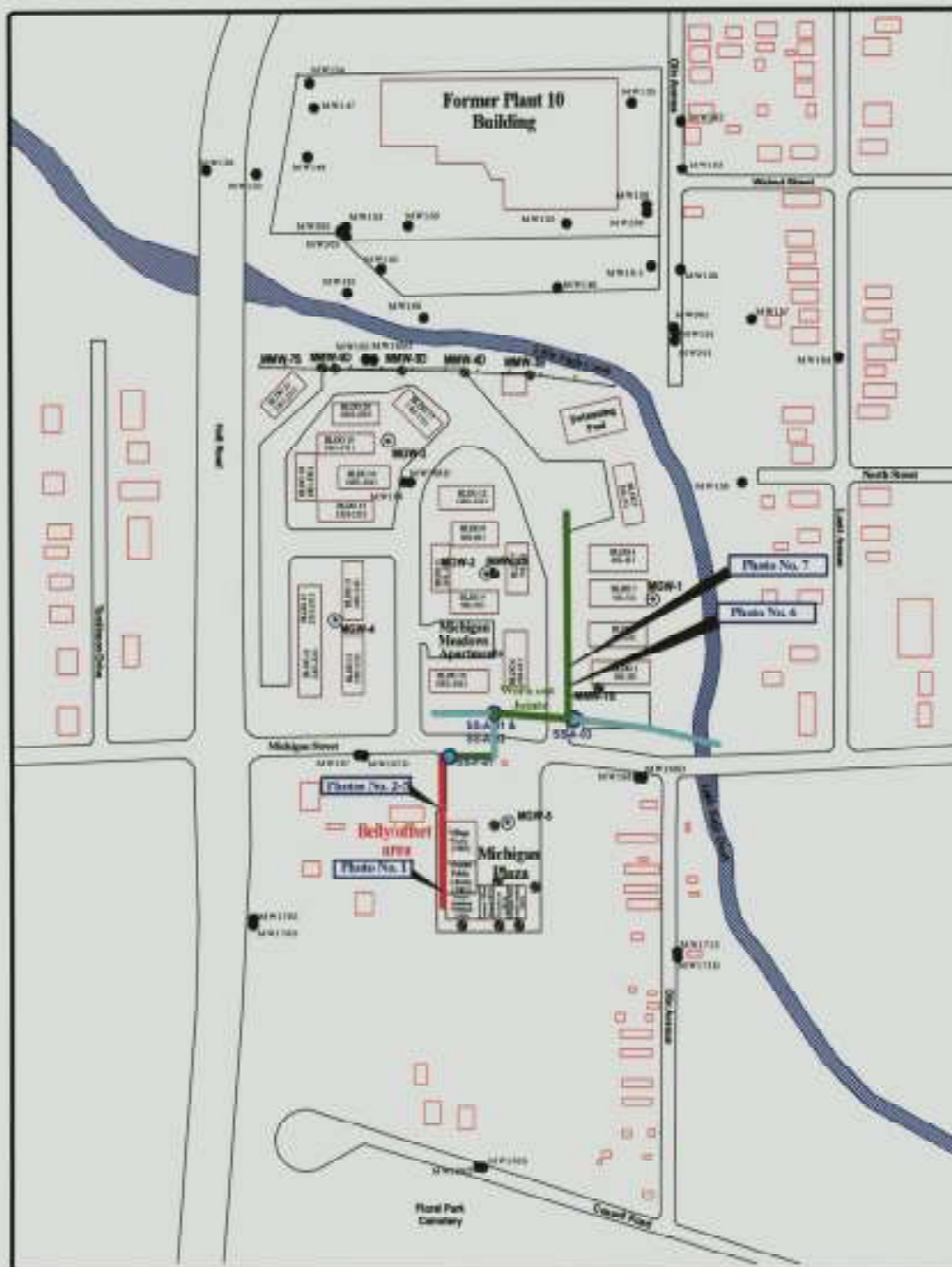
14



- 

20

FIGURE  
15



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Bene Min.SCF  
Date Prepared:  
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Scale:  
1"=200' ±

**SEWER INVESTIGATION**  
**Further Site Characterization**  
**Michigan Plaza**  
3801-3823 West Michigan Avenue  
Indianapolis, Indiana

FIGURE

**16**





### LEGEND

- Fence
- Karanda Monitoring Well
- MUNDALL Monitoring Wells (September 2005)
- MUNDALL Sewer Sampling Locations (September 2005)
- MUNDALL Soil Boring Locations (September 2005)
- Sewer Line Location

Sample Location	Sample Date
SS-P-01	11/03/05
SS-P-02	11/03/05
SB-P-01	11/03/05
SB-P-02	11/03/05



SCALE 0 200

Notes:  
Karanda Monitoring Well Location Estimated  
from Karanda Environmental, Inc.  
Project No. 2029  
March 11, 2002

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M01046  
Drawing File:  
Base Map.SKF  
Date Prepared:  
11/03/05  
Scale:  
1"=200'

**SEWER ANALYTICAL RESULTS**  
**Further Site Characterization**  
**Michigan Plaza**  
**3801-3823 West Michigan Avenue**  
**Indianapolis, Indiana**

FIGURE

17



# **LEGEND**

- Fence
- Remote Monitoring Wells
- SB-P-1 to SB-P-4 MRNDELL Soil Boring Locations (September & November 2005)
- OP-10 MRNDELL Soil Boring Locations (September 2005)
- MRNDELL Monitoring Wells, Michigan Plaza (September 2005)
- Total PCE concentration in groundwater, ppb
- Total PCE concentration in groundwater, ppb
- Sewer Line Location



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MD1046  
Drawing File:  
Base Map.SKP  
Date Prepared:  
12/30/05  
Scale:  
1"=200'

**HORIZONTAL EXTENT OF PCE IMPACTS TO  
GROUNDWATER (DEEP & SHALLOW SYSTEM)**  
Further Site Characterization  
Michigan Plaza  
3801-3823 West Michigan Street  
Indianapolis, Indiana

FIGURE

**18**







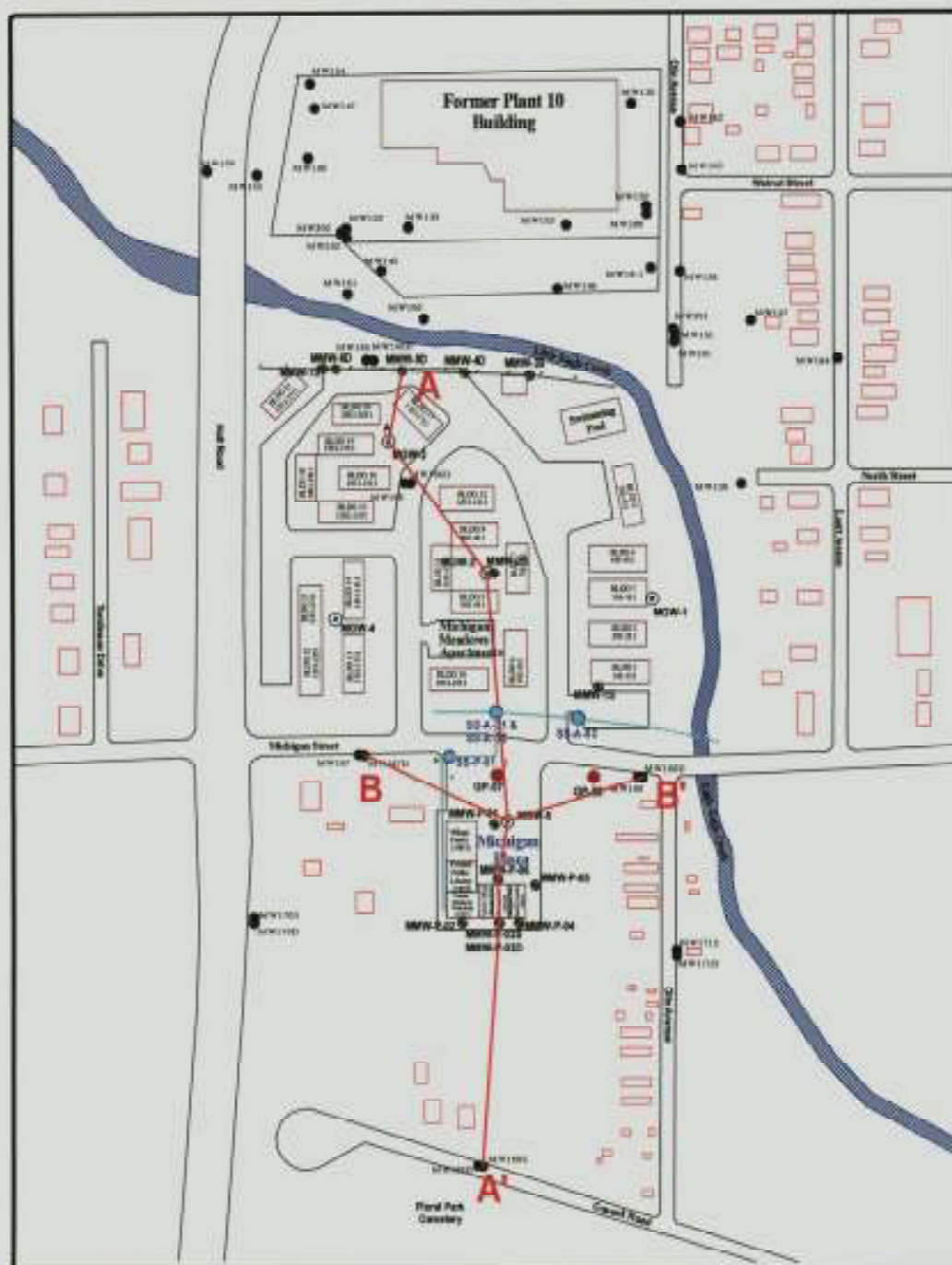












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 M01046  
 Drawing File:  
 Base Map SBCF  
 Date Prepared:  
 11/05/05  
 Scale:  
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**GEOLOGIC CROSS-SECTION LOCATIONS**  
**Further Site Characterization**  
 Michigan Apartments and Plaza  
 3800-3823 West Michigan Avenue  
 Indianapolis, Indiana

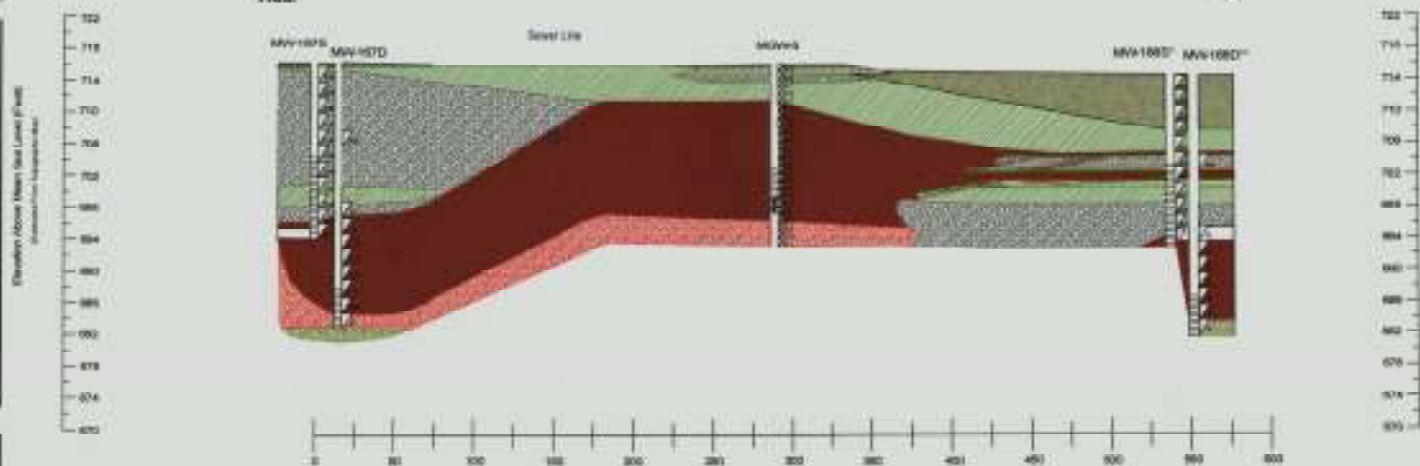
**FIGURE**

**24**

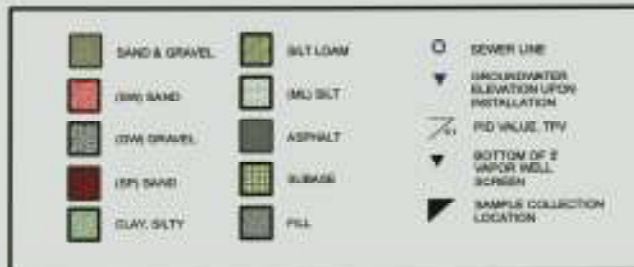


B  
West

B'  
East



**LEGEND**



\*Clayey sand and silt at 10.5-18' depth.  
\*\*Blind drilled at 0-10' depth.



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2	01/10/00	ISSUED FOR PERMIT	JM	JS	01/10/00	2	2	2
3	01/10/00	ISSUED FOR PERMIT	JM	JS	01/10/00	3	3	3
4	01/10/00	ISSUED FOR PERMIT	JM	JS	01/10/00	4	4	4
5	01/10/00	ISSUED FOR PERMIT	JM	JS	01/10/00	5	5	5
6	01/10/00	ISSUED FOR PERMIT	JM	JS	01/10/00	6	6	6
7	01/10/00	ISSUED FOR PERMIT	JM	JS	01/10/00	7	7	7
8	01/10/00	ISSUED FOR PERMIT	JM	JS	01/10/00	8	8	8
9	01/10/00	ISSUED FOR PERMIT	JM	JS	01/10/00	9	9	9
10	01/10/00	ISSUED FOR PERMIT	JM	JS	01/10/00	10	10	10

**GENERAL USE GEOLOGIC CROSS-SECTION B-B'**  
(East-West)  
Michigan Meadows Apartment and Michigan Plaza  
3500-3623 Third Michigan Avenue  
Indianapolis, IN

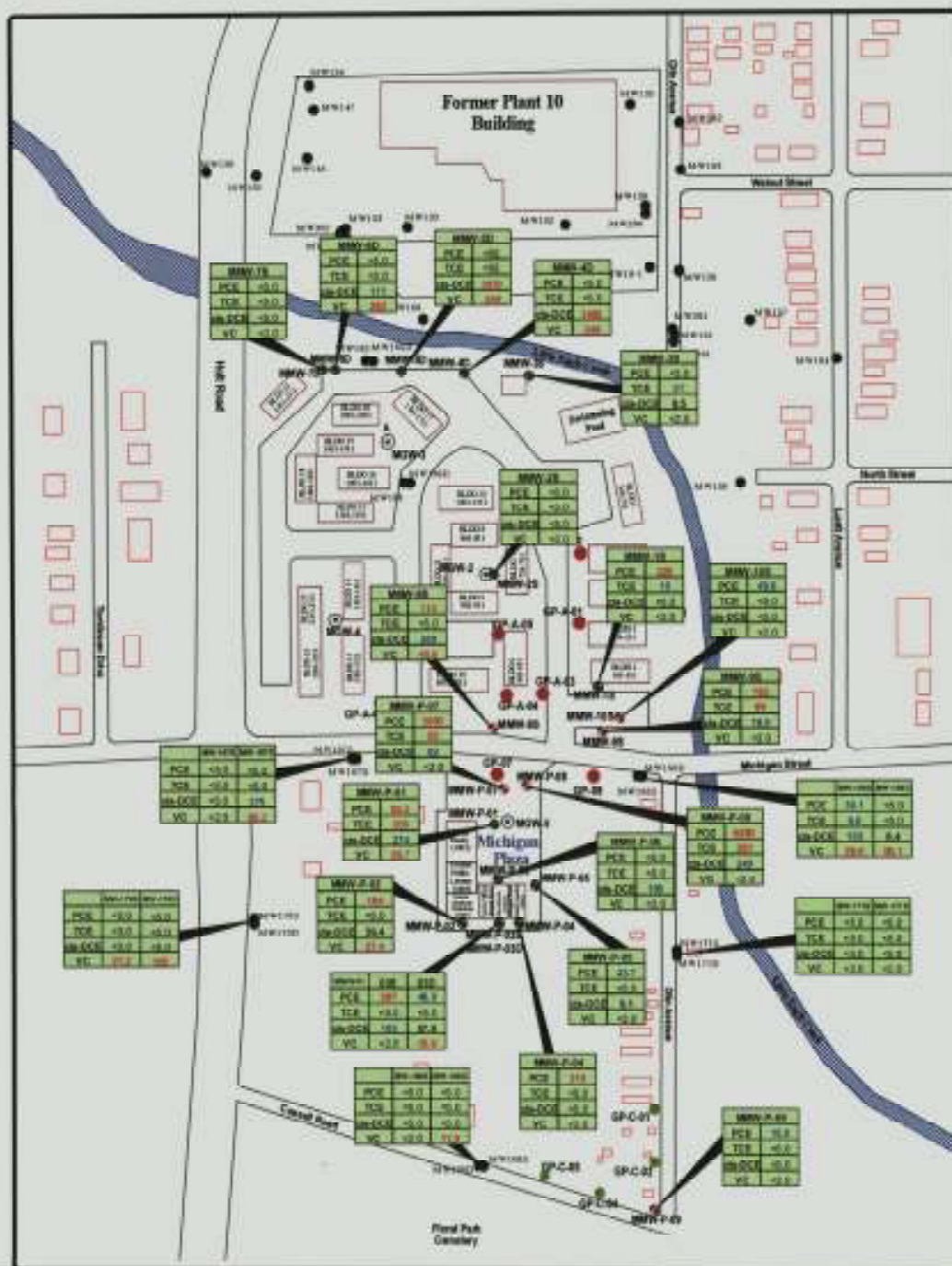
**FIGURE**  
**26**











### LEGEND

- Fence
- MW-100 ● Karanda Monitoring Wells
- GP-A-01 ● MUNDILL Sewer Sampling Locations (September & November 2003)
- GP-A-02 ● MUNDILL Soil Boring Locations (September 2007)
- MW-P-01 ● MUNDILL Monitoring Wells, Michigan Plaza (September 2007)
- GP-C-01 ● MUNDILL Soil Boring Locations (January 2007)
- MW-P-02 ● MUNDILL Monitoring Wells (January 2007)

Well ID		Top P-4	
Trichloroethylene	mg/L	mg/L	mg/L
Trichloroethene	mg/L	mg/L	mg/L
1,1,2-Trichloroethane	mg/L	mg/L	mg/L
Vinyl Chloride	mg/L	mg/L	mg/L

**NOTE:**  
Values in **RED** are above RISC Industrial Cleanup Goals and those in **BLUE** are above RISC Residential Cleanup Goals



SCALE 0 200

Plant  
Karanda Monitoring Well Locations (Reference)  
Area Karanda Site Remedial, Inc.  
Project No. 2021  
March 17, 2002

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Project Number:  
M01046  
Drawing File:  
Basis Map SKP  
Date Prepared:  
3/12/07  
Scale:  
1"=200' ±

Monitoring Well Sampling  
Groundwater Analytical Results  
Further Site Investigation Addendum I  
February 21-22, 2007  
Michigan Plaza  
Indianapolis, Indiana

FIGURE

29





# **LEGEND**

- River
- Research Monitoring Well
- MW-01 ● MUNDALL Source Sampling Locations (September & November 2005)
- SP-01 ● MUNDALL Soil Boring Locations (September 2005)
- MW-02 ● MUNDALL Monitoring Wells, Michigan Plaza (September 2005)
- MW-03 ● MUNDALL Monitoring Wells (January 2007)
- Total PCE concentration in groundwater, ppb
- Sewer Line Location
- Total PCE concentration in groundwater, ppb

NOTE:  
Values in **RED** are above  
RISC Industrial Cleanup  
Goals and those in **BLUE**  
are above RISC Residential  
Cleanup Goals



SCALE: 1"=200'

East  
Environmental Monitoring Well Locations (Reference)  
East Environmental Monitoring, Inc.  
Project No. 2221  
March 13, 2007

**MUNDALL & ASSOCIATES, INC.**

*Consulting Professionals for the Earth & Environment*

479 East Vermont Street, Suite 200  
Indianapolis, Indiana 46202-3688  
317-670-0000, Fax 317-670-9000

Project Number:  
M01086  
Drawing File:  
P01-M01086  
Date Prepared:  
4/12/07  
Scale:  
1"=200'

**HORIZONTAL EXTENT OF PCE IMPACTS TO  
GROUNDWATER (SHALLOW SYSTEM)**  
**Further Site Characterization**  
Michigan Plaza  
3801-3823 West Michigan Street  
Indianapolis, Indiana

**FIGURE  
31A**





# LEGEND

- Fence
- MW-1 through MW-100: Monitoring Wells
- MW-1 through MW-100: Monitoring Wells (September & November 2005)
- MW-1 through MW-100: Monitoring Wells (January 2007)
- MW-1 through MW-100: Monitoring Wells (Michigan Plaza (September 2005))
- MW-1 through MW-100: Monitoring Wells (January 2007)
- TCE Concentrations in groundwater, ppb
- TCE Chloride Concentration, ppb

NOTE:  
Values in RED are above  
RISC Industrial Cleanup  
Goals and those in BLUE  
are above RISC Residential  
Cleanup Goals



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429 East Vermont Street, Suite 200  
Indianapolis, Indiana 46202-3689  
317-630-9060, Fax 317-630-9061

Project Number:  
301046  
Drawing Title:  
Plan Map-SST  
Date Prepared:  
4/2/07  
Scale:  
1"=200'

HORIZONTAL EXTENT OF TCE IMPACTS  
TO GROUNDWATER (Shallow System)  
Further Site Characterization  
Michigan Plaza  
3801-3823 West Michigan Street  
Indianapolis, Indiana

FIGURE  
31B





# **LEGEND**

- Pipe
- Potable Monitoring Wells
- SP-1 through SP-104 MUNDALL Source Sampling Locations (September & November 2005)
- SP-1 through SP-104 MUNDALL Soil Boring Locations (September 2005)
- MW-1 through MW-104 MUNDALL Monitoring Wells, Michigan Plaza (September 2005)
- MW-1 through MW-104 MUNDALL Monitoring Wells (January 2007)
- VC-1 through VC-104 Vinyl Chloride Concentration in groundwater, ppb
- VC-1 through VC-104 Vinyl Chloride Concentration, ppb
- Sewer Line Location

**NOTE:**  
Values in **RED** are above  
RISC Industrial Cleanup  
Goals and those in **BLUE**  
are above RISC Residential  
Cleanup Goals



SCALE: 1" = 100'  
1" = 100'  
1" = 100'  
1" = 100'

**MUNDALL & ASSOCIATES, INC.**

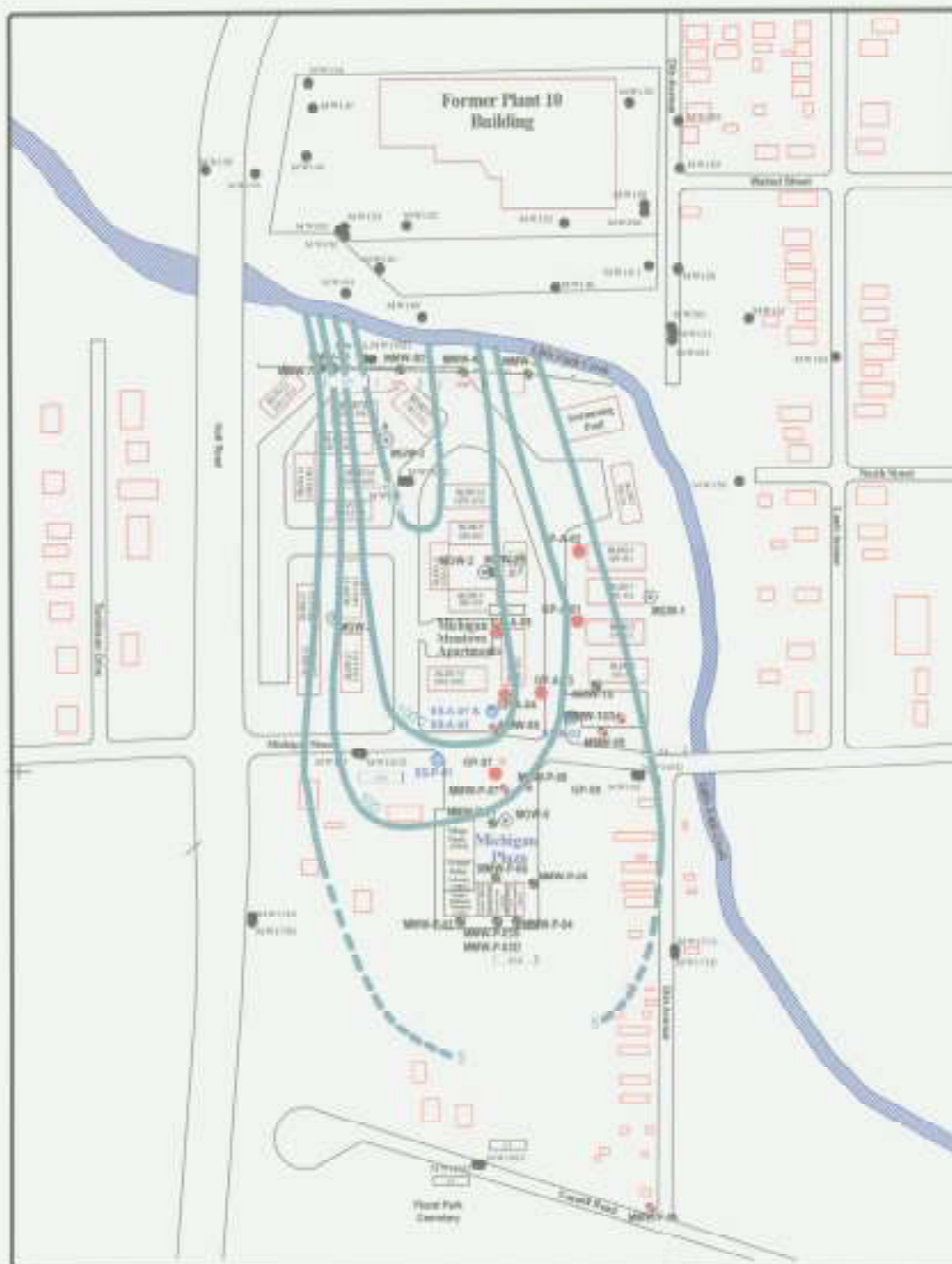
*Consulting Professionals for the Earth & Environment*

429 East Vermont Street, Suite 200  
Indianapolis, Indiana 46202-3688  
317-630-9000, fax 317-630-9061

Project Number:  
M01046  
Drawing Title:  
Plan Map SET  
Date Prepared:  
04/03/2007  
Scale:  
1" = 100' ±

**HORIZONTAL EXTENT OF VC IMPACTS  
TO GROUNDWATER (SHALLOW SYSTEM)**  
**Further Site Characterization**  
Michigan Plaza  
3801-3821 West Michigan Street  
Indianapolis, Indiana

**FIGURE  
31D**



### LEGEND

- Fence
- Remote Monitoring Wells
- SP-1 ● MUNDALL Series Sampling Locations (September & November 2005)
- SP-2 ● MUNDALL Series Sampling Locations (September 2005)
- MW-1 ● MUNDALL Monitoring Wells, Michigan Plaza (September 2005)
- MW-2 ● MUNDALL Monitoring Wells (January 2007)
- cis-1,2-DCE Concentration in groundwater, ppb
- cis-1,2-DCE Concentration, ppb

NOTE:  
Values in **RED** are above  
RISC Industrial Cleanup  
Goals and those in **BLUE**  
are above RISC Residential  
Cleanup Goals



SCALE: 1" = 200'

Source: Monitoring Well Locations (Reference)  
Data: Groundwater Data (Reference, Inc.)  
Project No. 2007  
March 11, 2008

## MUNDALL & ASSOCIATES, INC.

Consulting Professionals for the Earth & Environment

479 East Vermont Street, Suite 200  
Indianapolis, Indiana 46202-3688  
317-639-9080, fax 317-639-9085

Project Number:  
M0106  
Drawing File:  
Plan M0106  
Date Prepared:  
04/05/07  
Scale:  
1"=200'

**HORIZONTAL EXTENT OF cis-1,2-DCE IMPACTS  
TO GROUNDWATER (DEEP SYSTEM)**  
**Further Site Characterization**  
Michigan Plaza  
3801-3823 West Michigan Street  
Indianapolis, Indiana

FIGURE

**32A**







## LEGEND

- Forest
- Canawha Monitoring Well
- MUNELL Creek Sampling Locations February 2007 (Approximate)
- MUNELL River Sampling Locations (September & November 2007)
- MUNELL Soil Boring Locations (September 2007)
- MUNELL Monitoring Wells, Michigan Plaza (September 2007)
- MUNELL Soil Boring Locations (January 2007)
- MUNELL Monitoring Wells (January 2007)

Sample #1	
PCB	Trichlorobenzene (ug/L)
TCE	Trichloroethylene (ug/L)
1,2-DCE	1,2-Dichloroethene (ug/L)
VC	Vinyl Chloride (ug/L)



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429 East Vermont Street, Suite 200  
Indianapolis, Indiana 46202-3668  
317-630-9080, fax 317-630-9065

Project Number:  
M01046  
Drawing Title:  
Data Map(SK)  
Date Prepared:  
1/2007  
Scale:  
1"=200'

Surface Water Analytical Results  
February 21, 2007  
Michigan Plaza  
Indianapolis, Indiana

FIGURE  
32C



# LEGEND

- Street
- Existing Monitoring Wells
- MUNDILL Monitoring Wells (May-June 2007)
- MUNDILL Soave Sampling Locations (September & November 2005)
- MUNDILL Soil Boring Locations (September 2005)
- MUNDILL Monitoring Wells, Michigan Plaza (September 2007)
- MUNDILL Soil Boring Locations (January 2007)
- MUNDILL Monitoring Wells (January 2007)

Soil Boring Log Key	
PT-1	Testimony/Investigation Log No. 1
PT-2	Testimony/Investigation Log No. 2
PT-3	Testimony/Investigation Log No. 3
PT-4	Testimony/Investigation Log No. 4
PT-5	Testimony/Investigation Log No. 5
PT-6	Testimony/Investigation Log No. 6
PT-7	Testimony/Investigation Log No. 7
PT-8	Testimony/Investigation Log No. 8
PT-9	Testimony/Investigation Log No. 9
PT-10	Testimony/Investigation Log No. 10

NOTE:  
Values in **PT-1** are from 2007 National  
Change Check and from 2007  
from 2007. Additional Change Check.



SCALE  
0 100 200  
Feet  
Kornelius Monitoring Well Location Pathway  
East Environmental, Inc.  
Project No. 220  
March 12, 2007

## MUNDELL & ASSOCIATES, INC.

Consulting Professionals for the Earth & Environment

429 East Vermont Street, Suite 200  
Indianapolis, Indiana 46202-3608  
317-630-9060, fax 317-630-9065

Project Number:  
M01006  
Drawing File:  
Plan Map 582  
Date Prepared:  
7/3/07  
Scale:  
1"=200'

Soil Analytical Map  
Sample Date: May 31, 2007  
Michigan Plaza  
3801-3823 West Michigan Street  
Indianapolis, Indiana

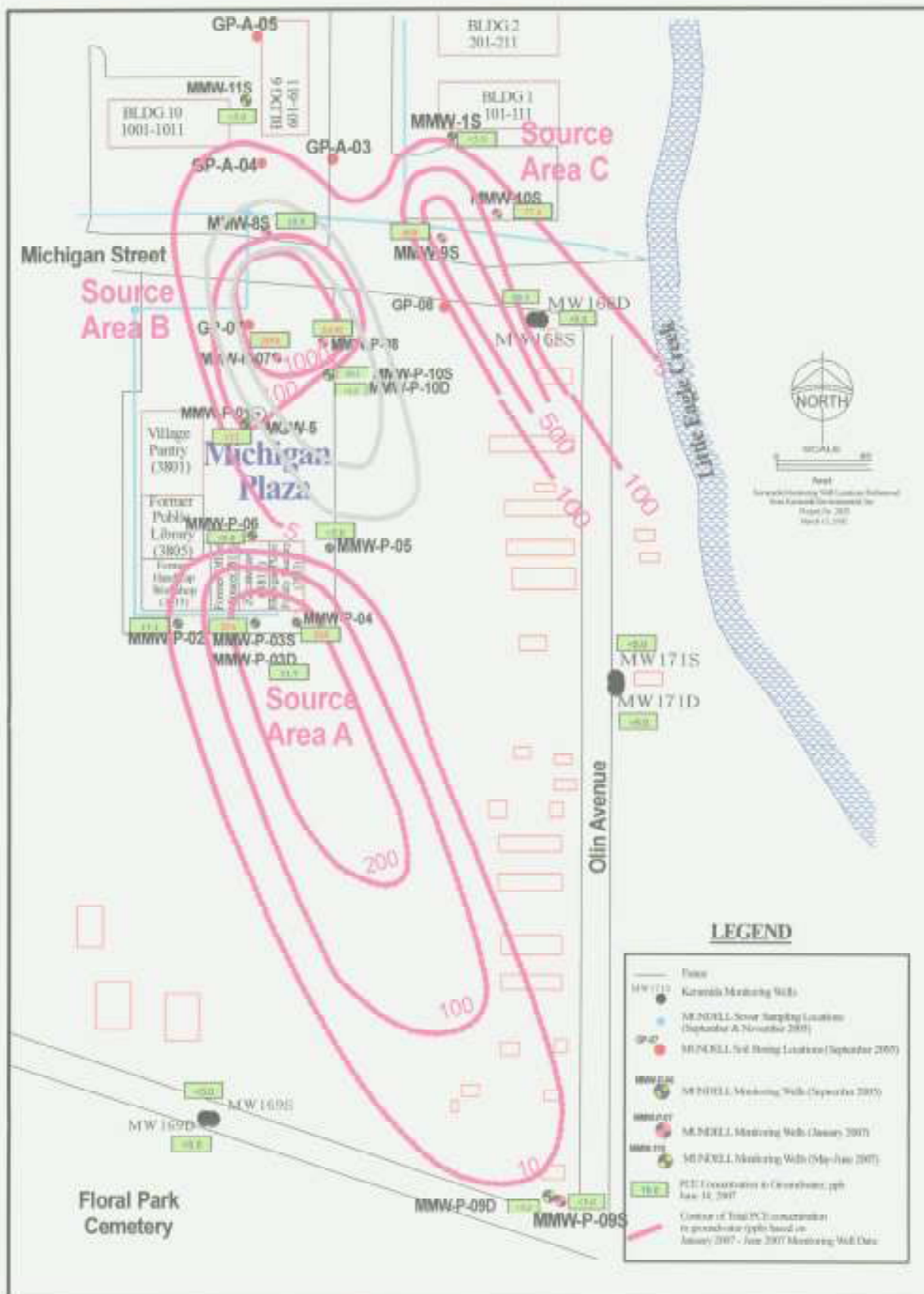
FIGURE

33









**MUNDELL & ASSOCIATES, INC.**

*Consulting Professionals for the Earth & Environment*

429 East Vermont Street, Suite 200

Indianapolis, Indiana 46202-3801

317-430-0060 Fax 317-630-0065

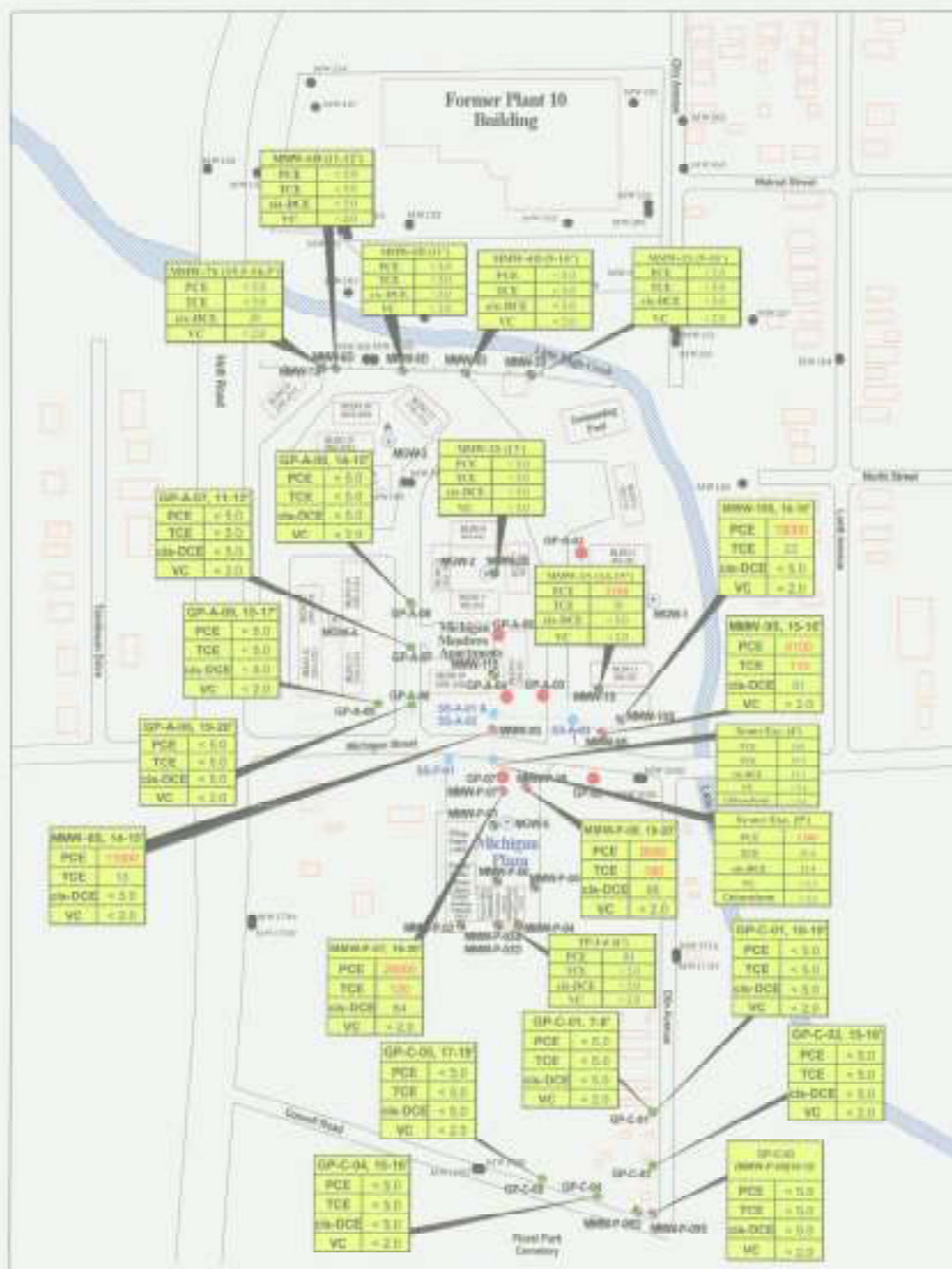
Project Number:  
M2006  
Drawing File:  
Remediation Oct 3  
Date Prepared:  
4/27/07  
Scale:  
1"=400'

**Revised PCE Plume Map (June 2007)**

Michigan Plaza  
3801-3823 West Michigan Street  
Indianapolis, Indiana

**FIGURE**

**36**



# **MUNDRELL & ASSOCIATES, INC.**

Consulting Professionals for the Earth & Environment

110 South Downey Avenue  
 Indianapolis, Indiana 46219  
 317-630-0060, fax 317-630-0065

Project Number:  
 MND-001  
 Drawing File:  
 Base Map SKI  
 Date Prepared:  
 1/10/05  
 Scale:  
 1"=200'

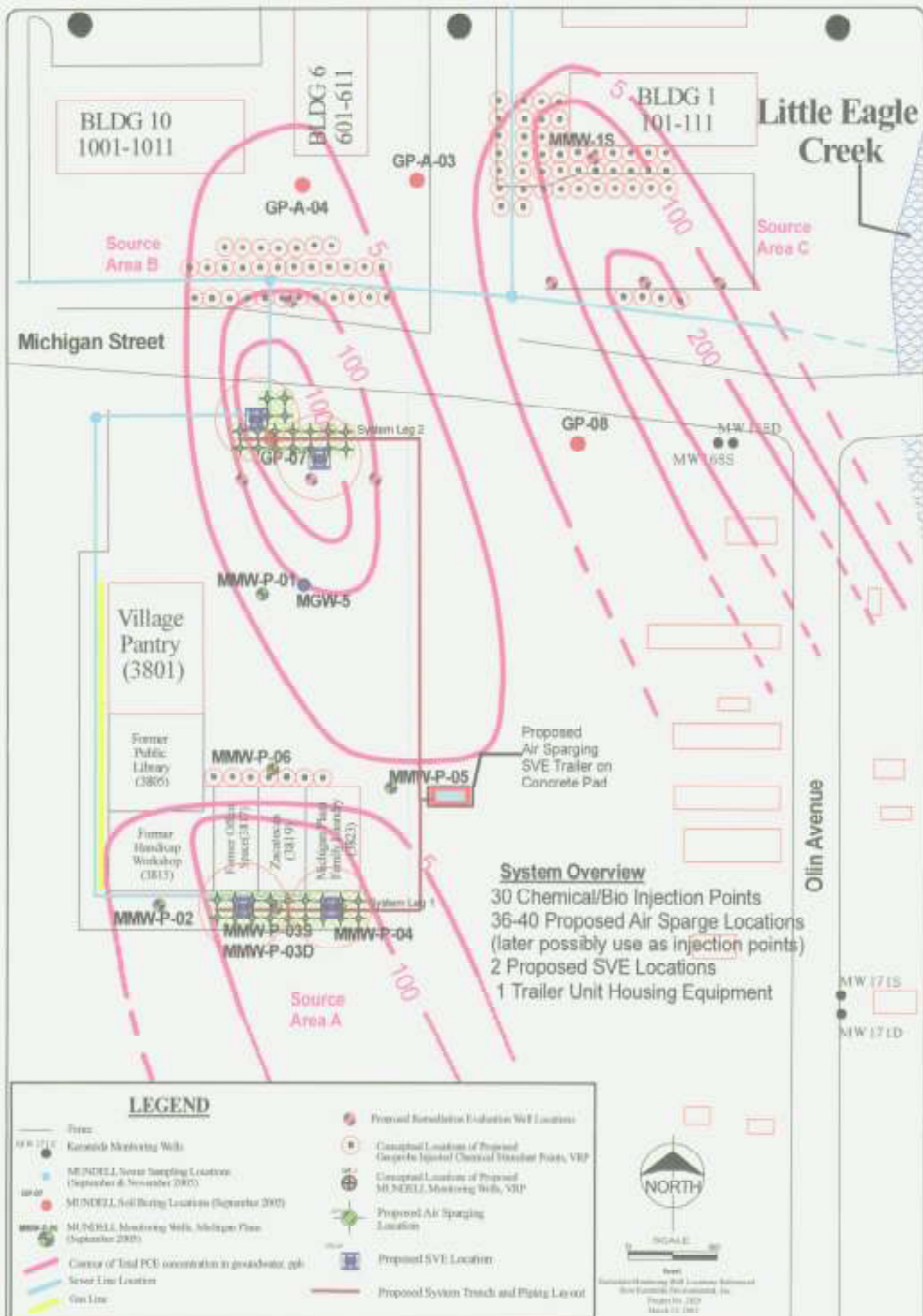
## **Historical Soil Analytical Results (Composited) Remediation Work Plan**

Michigan Plaza  
 Indianapolis, Indiana

FIGURE

37





**MUNDELL & ASSOCIATES, INC.**  
*Consulting Professionals for the Earth & Environment*  
429 East Vermont Street, Suite 200  
Indianapolis, Indiana 46202-3608  
317-430-9060, fax 317-630-9065

**Remediation System Conceptual Diagram**  
Hybrid In Situ Injection & SVE/AS System  
Voluntary Remediation Program  
Michigan Plaza  
3801-3823 West Michigan Street  
Indianapolis, Indiana

**FIGURE 38**

# Michigan Meadows Apartments



0 20 40  
Scale: 1 inch = 80 feet

Residential Area



Michigan Plaza

Residential Area



MICHIGAN STREET

Little Eagle Creek

## LEGEND

MUNDILL Air Mitigation System Locations (September 2006)

Floral Park Cemetery Property

MUNDILL & ASSOCIATES, INC.  
Consulting Engineers and Architects

3801-3823 West Michigan Street  
Indianapolis, Indiana 46204-1001  
317-633-1000

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DATE	DESCRIPTION	BY	APPROVED

REVISION	DATE	DESCRIPTION
1	11/1/2006	ISSUED FOR PERMIT
2	11/1/2006	ISSUED FOR PERMIT
3	11/1/2006	ISSUED FOR PERMIT

AIR MITIGATION SYSTEM LOCATIONS  
Remediation Work Plan  
MICHIGAN PLAZA  
3801-3823 West Michigan Street  
Indianapolis, Indiana

FIGURE  
39

# Michigan Meadows Apartments



0 30 60

Scale: 1 inch = 60 feet

## LEGEND

- MUNDRELL Sampling Air Mitigation System Location (September 2006)
- MUNDRELL Monitoring Well Location (September 2005)
- MUNDRELL Air Quality Sampling Location (April 23 & 24, 2003)
- MUNDRELL Indoor Air Quality Sampling Location (Oct. 2004)
- MUNDRELL Below-Grnd Water Sampling Location (Oct. 2004)
- MUNDRELL Indoor Air Quality Sampling Location (Sep 2003 and Oct 2004)
- MUNDRELL Monitoring Gas Well
- MUNDRELL Ambient Air Sample (Oct 2006)

Sample Location	
PCE	Tetrachloroethene (ugm/l)
TCE	Trichloroethene (ugm/l)
cis-1,2-DCE	cis-1,2-Dichloroethene (ugm/l)
VC	Vinyl chloride (ugm/l)

Residential Area

VILLAGE PARTIAL			
4/20/03	8/20/03	10/10/04	
PCE	1.00	1.00	0.70
TCE	0.10	0.10	0.10
cis-1,2-DCE	0.10	0.10	0.10
VC	0.10	0.10	0.10

MCH PLAZA PARTIAL			
4/20/03	8/20/03	10/10/04	
PCE	1.00	1.00	0.70
TCE	0.10	0.10	0.10
cis-1,2-DCE	0.10	0.10	0.10
VC	0.10	0.10	0.10

PLAZA PARTIAL			
4/20/03	8/20/03	10/10/04	
PCE	1.00	1.00	0.70
TCE	0.10	0.10	0.10
cis-1,2-DCE	0.10	0.10	0.10
VC	0.10	0.10	0.10

MICHIGAN STREET

Residential Area

Little Eagle Creek

MMW-P-01

Michigan Plaza

MMW-P-06

MMW-P-05

MMW-P-02

MMW-P-03

MMW-P-04

MMW-P-07

MMW-P-08

MMW-P-09

MMW-P-10

MMW-P-11

MMW-P-12

MMW-P-13

MMW-P-14

MMW-P-15

MMW-P-16

MMW-P-17

MMW-P-18

MMW-P-19

MMW-P-20

MMW-P-21

MMW-P-22

MMW-P-23

MMW-P-24

MMW-P-25

MMW-P-26

MMW-P-27

MMW-P-28

MMW-P-29

MMW-P-30

MMW-P-31

MMW-P-32

MMW-P-33

MMW-P-34

MMW-P-35

MMW-P-36

MMW-P-37

MMW-P-38

MMW-P-39

MMW-P-40

MMW-P-41

MMW-P-42

MMW-P-43

MMW-P-44

MMW-P-45

MMW-P-46

MMW-P-47

MMW-P-48

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MMW-P-105

MMW-P-106

MMW-P-107

MMW-P-108

MMW-P-109

MMW-P-110

MMW-P-111

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MMW-P-115

MMW-P-116

MMW-P-117

MMW-P-118

MMW-P-119

MMW-P-120

MMW-P-121

MMW-P-122

MMW-P-123

MMW-P-124

MMW-P-125

MMW-P-126

MMW-P-127

MMW-P-128

MMW-P-129

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MMW-P-145

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MMW-P-148

MMW-P-149

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MMW-P-152

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MMW-P-159

MMW-P-160

MMW-P-161

MMW-P-162

MMW-P-163

MMW-P-164

MMW-P-165

MMW-P-166

MMW-P-167

MMW-P-168

MMW-P-169

MMW-P-170

MMW-P-171

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MMW-P-173

MMW-P-174

MMW-P-175

MMW-P-176

MMW-P-177

MMW-P-178

MMW-P-179

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MMW-P-181

MMW-P-182

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MMW-P-188

MMW-P-189

MMW-P-190

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MMW-P-192

MMW-P-193

MMW-P-194

MMW-P-195

MMW-P-196

MMW-P-197

MMW-P-198

MMW-P-199

MMW-P-200

MMW-P-201

MMW-P-202

MMW-P-203

MMW-P-204

MMW-P-205

MMW-P-206

MMW-P-207

MMW-P-208

MMW-P-209

MMW-P-210

MMW-P-211

MMW-P-212

MMW-P-213

MMW-P-214

MMW-P-215

MMW-P-216

MMW-P-217

MMW-P-218

MMW-P-219

MMW-P-220

MMW-P-221

MMW-P-222

MMW-P-223

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MMW-P-225

MMW-P-226

MMW-P-227

MMW-P-228

MMW-P-229

MMW-P-230

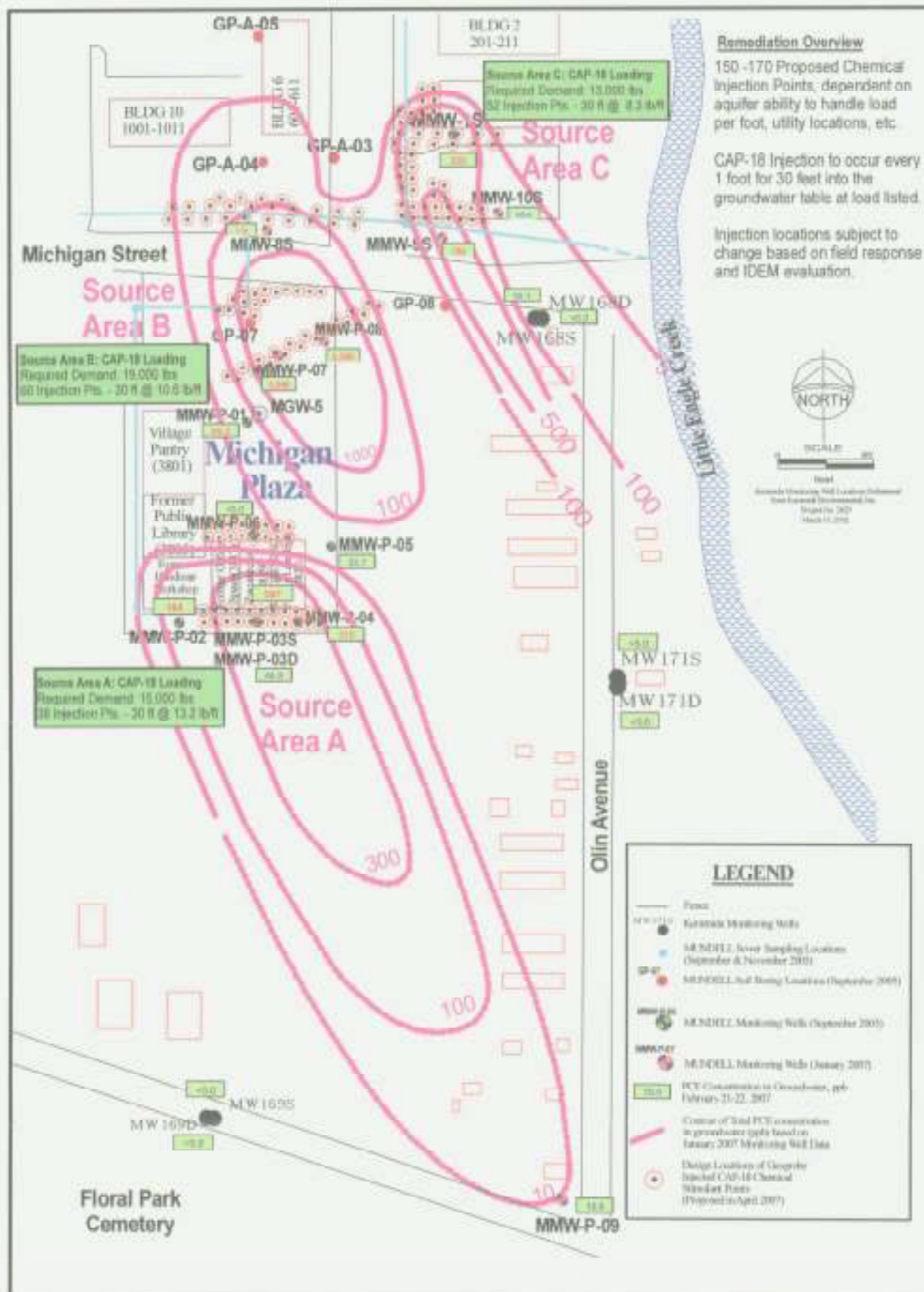
MMW-P-231

MMW-P-232

MMW-P-233

MMW-P-234

MMW-P-235



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*Consulting Professionals for the Earth & Environment*

429 East Vermont Street, Suite 200  
 Indianapolis, Indiana 46202-3688  
 317-636-9660, Fax 317-636-9663

Project Number:  
 500556  
 Drawing File:  
 Remediation Cap 2  
 Date Prepared:  
 4/27/07  
 Scale:  
 1"=40'

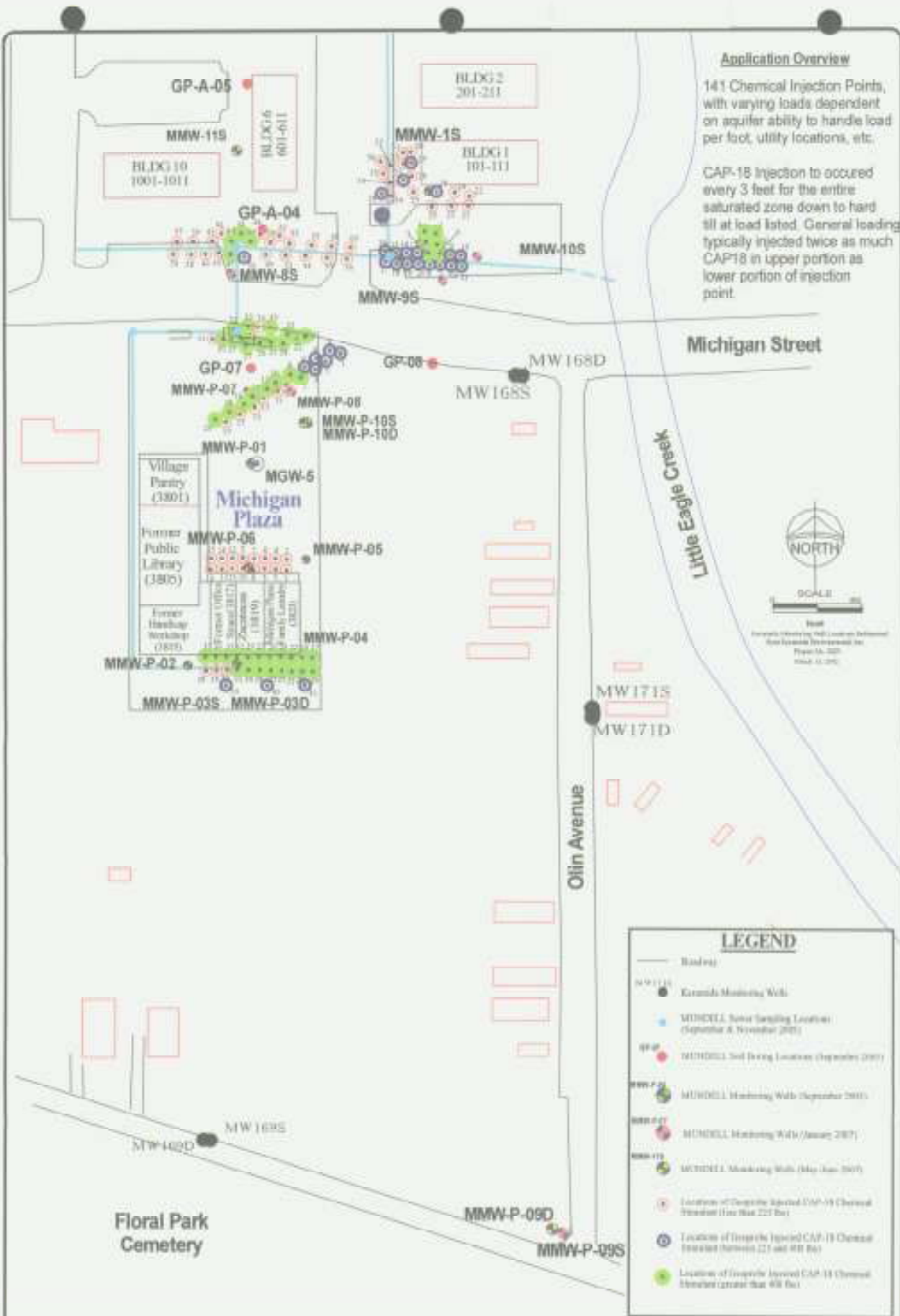
**PROPOSED REMEDIAL DESIGN**  
 Michigan Plaza  
 3801-3823 West Michigan Street  
 Indianapolis, Indiana

FIGURE

**41**







#### Application Overview

141 Chemical Injection Points, with varying loads dependent on aquifer ability to handle load per foot, utility locations, etc.

CAP-18 Injection to occurred every 3 feet for the entire saturated zone down to hard till at load listed. General loading typically injected twice as much CAP18 in upper portion as lower portion of injection point.



SCALE

Scale  
Horizontal Distance and Well Location Defined  
Scale: 1 inch = 200 feet  
Date: 11/1/2007  
Sheet: 11 of 11

#### LEGEND

- Roadway
- Kansas Monitoring Wells
- MUNDRELL Soil Sampling Locations (September & November 2007)
- MUNDRELL Soil Drilling Locations (September 2007)
- MUNDRELL Monitoring Wells (September 2007)
- MUNDRELL Monitoring Wells (January 2007)
- MUNDRELL Monitoring Wells (May/June 2007)
- Locations of Geoprobe Injected CAP-18 Chemical Remediation (Less than 225 feet)
- Locations of Geoprobe Injected CAP-18 Chemical Remediation (Between 225 and 400 feet)
- Locations of Geoprobe Injected CAP-18 Chemical Remediation (Greater than 400 feet)

**MUNDRELL & ASSOCIATES, INC.**

Consulting Professionals for the Earth & Environment

110 South Duane Avenue  
Indianapolis, Indiana 46219  
317-630-9969, fax 317-630-9063

Project Number  
M0104M

Drawing File:

Date Prepared  
12/9/07  
Scale  
1"=50'

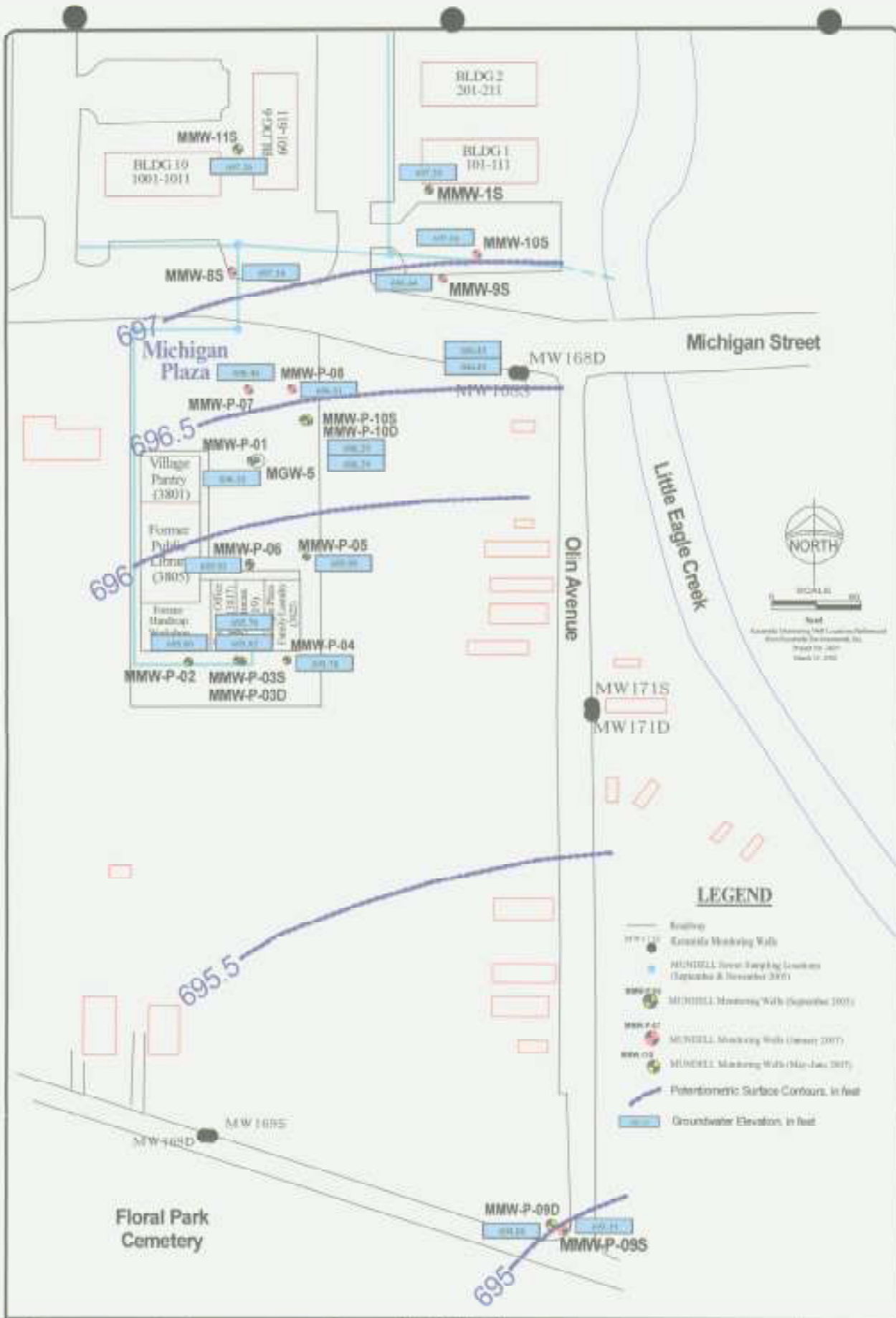
**CAP18 INJECTION REMEDIATION**  
(Injected August 2007)  
Michigan Plaza  
3801-3823 West Michigan Street  
Indianapolis, Indiana

FIGURE

**43**







**MUNDELL & ASSOCIATES, INC.**

*Consulting Professionals for the Earth & Environment*

419 East Vermont Street, Suite 200  
Indianapolis, Indiana 46202-3688  
317.420.0000 fax 317.630.9087

Project Number  
M070260  
Drawing File  
D070260.mxd  
Date Prepared  
11/9/07  
Scale  
1"=80'

**POTENTIOMETRIC SURFACE MAP**

September 19, 2007

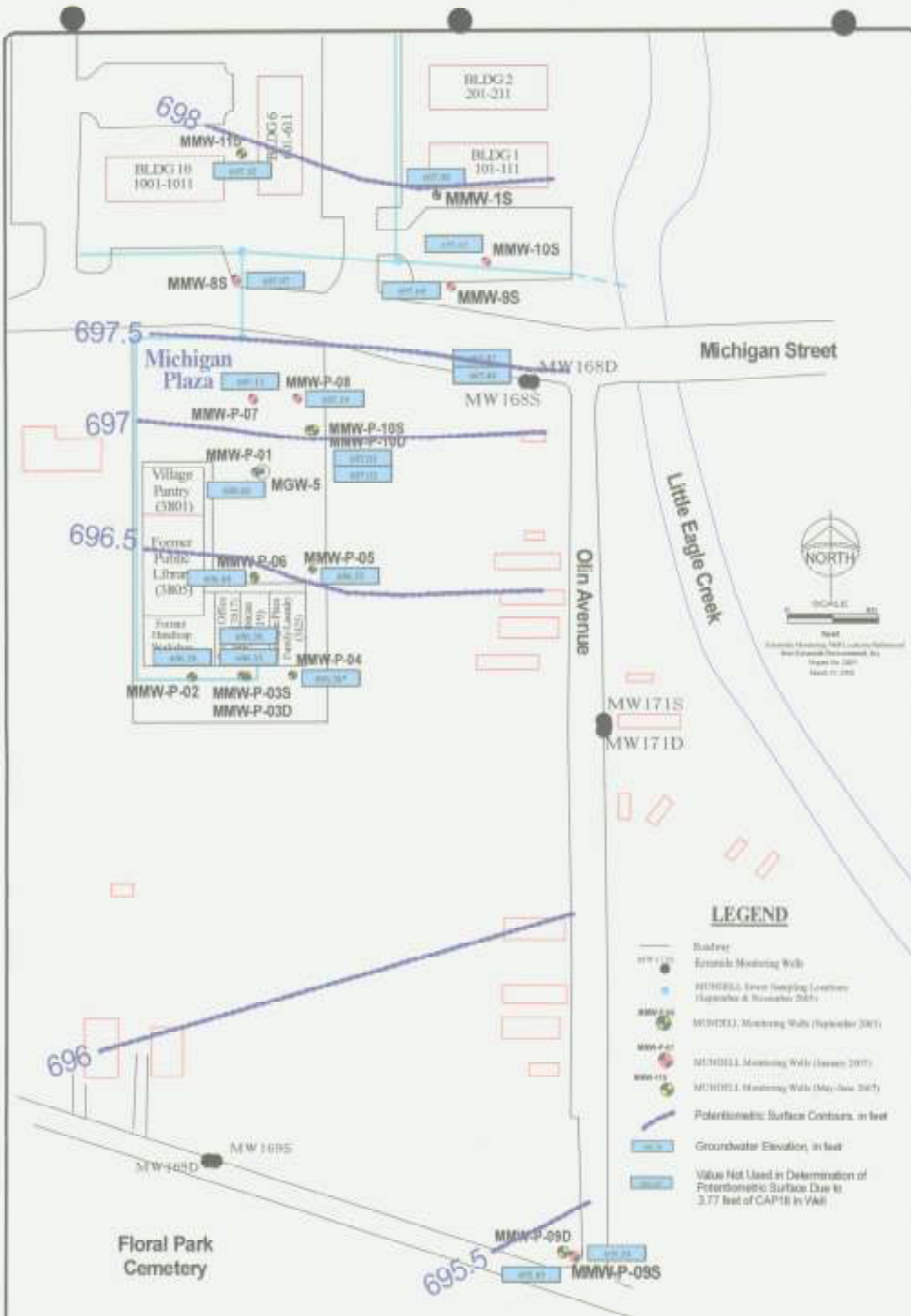
Michigan Plaza

3801-3823 West Michigan Street  
Indianapolis, Indiana

**FIGURE**

**45**





**MUNDELL & ASSOCIATES, INC.**

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110 South Dixie Avenue  
Indianapolis, Indiana 46219  
317-430-9880, fax 317-430-9883

Project Number:  
M01086  
Drawing File:  
Basemap.mxd  
Date Prepared:  
2/4/08  
Scale:  
1"=80'

**POTENTIOMETRIC SURFACE MAP**

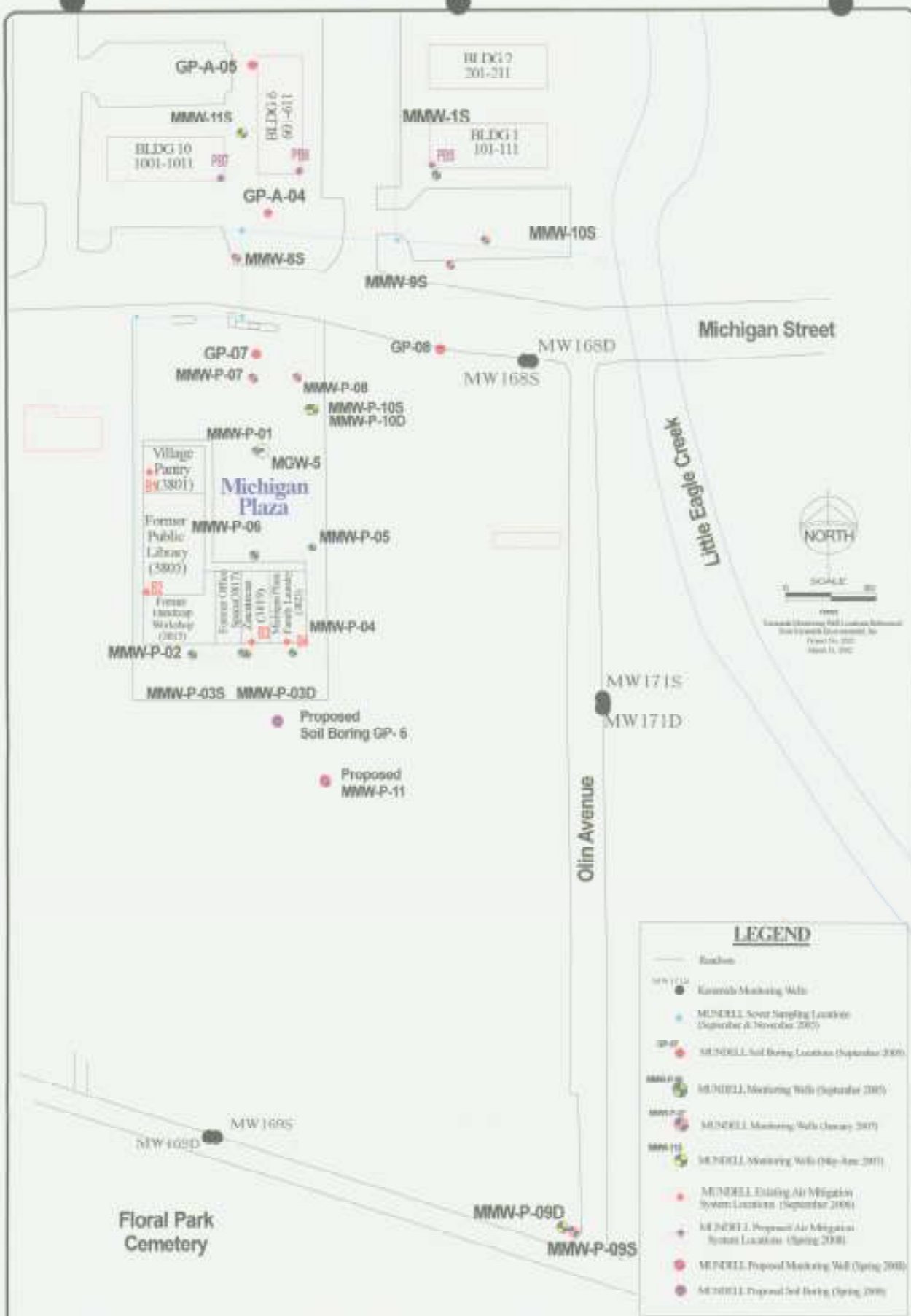
December, 2007  
Michigan Plaza  
3801-3823 West Michigan Street  
Indianapolis, Indiana

**FIGURE**

**47**



48



**MUNDELL & ASSOCIATES, INC.**

*Consulting Professionals for the Earth & Environment*

110 South Delaware Avenue  
Indianapolis, Indiana 46219  
317-630-9060, fax 317-630-9067

Project Number:

MM006

Drawing File:

MM006

Date Prepared:

1/31/06

Scale:

1"=30'

**PROPOSED ADDITION ACTIVITIES MAP**

Michigan Plaza  
3801-3823 West Michigan Street  
Indianapolis, Indiana

**FIGURE**

**49**





# **LEGEND**

- MW-101 • Remote Monitoring Wells
- MW-102 • Remote Monitoring Wells
- MW-103 • Monitoring Wells to be Sampled Quarterly
- MW-104 • Remote Monitoring Wells on Which Groundwater Levels Will be Monitored Quarterly
- MW-105 • Monitoring Wells to be Sampled Annually



SCALE  
0 100 200  
Feet

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March 12, 2002

## **MUNDELL & ASSOCIATES, INC.**

Consulting Professionals for the Earth & Environment

110 South Denney Avenue  
Indianapolis, Indiana 46219  
317-630-9090, Fax 317-630-9083

Project Number:  
M0106  
Drawing File:  
Plan Map.SCF  
Date Prepared:  
2/12/02  
Scale:  
1"=200'

## **GROUNDWATER MONITORING NETWORK Remediation Work Plan**

Michigan Plaza  
Indianapolis, Indiana

FIGURE

**50**

## TABLES

**Table 1**  
**Soil Analytical Results**  
**Phase II Investigation**  
**Michigan Meadows Apartments**  
**Indianapolis, Indiana**  
**MUNDELL Job No.: M01046**

Sample (Depth in feet)	Sample Date	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	Vinyl chloride
		ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
MMW-1S (14-15')	9/10/2004	2,100	19	< 5.0	< 5.0	< 2.0
MMW-2S (13')	9/10/2004	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0
MMW-3S (9-10')	9/10/2004	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0
MMW-4D (9-10')	9/10/2004	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0
MMW-5D (11')	9/10/2004	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0
MMW-6D (11-12')	9/10/2004	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0
MMW-7S (15.5-16.5')	9/10/2004	< 5.0	< 5.0	28	< 5.0	< 2.0
IDEM RISC 2006 Default Industrial Cleanup Level	-	640	82	5,800	14,000	13
IDEM RISC 2006 Default Residential Cleanup Level	-	58	57	400	680	13

**Note:**  
 All Values Over IDEM RISC Industrial Default Cleanup Level shown in **RED**  
 All Values Over IDEM RISC Residential Default Cleanup Level shown in **BLUE**  
 PCE = Tetrachloroethene; TCE = Trichloroethene; cis-1,2-DCE = cis-1,2-Dichloroethene; trans-1,2-DCE = trans-1,2-Dichloroethene  
 Data on this table was originally presented as Table 3 in MUNDELL's Phase II ESA (Michigan Apartments), dated May 5, 2005

**Table 2a**  
**Monitoring Well Details and Historical Water Levels**  
**Dates of Monitoring: September 10, 2004 - December 12, 2007**  
**Remediation Work Plan**  
**Michigan Plaza**  
**Indianapolis, IN**  
**MUNDELL Project No.: M01046**

Well	Date of Installation	Top of Casing Elevation (feet MSL)	Total Depth (feet)	Screened Interval (feet)	9/10/04 Depth to Water (feet)	9/10/04 Groundwater Elevation (feet MSL)	11/7/05 Depth To Water (feet)	11/7/05 Groundwater Elevation (feet MSL)	2/21/07 Depth to Water (feet)	2/21/07 Groundwater Elevation (feet MSL)	6/14/07 Depth To Water (feet)	6/14/07 Groundwater Elevation (feet MSL)	9/19/07 Depth To Water (feet)	9/19/07 Groundwater Elevation (feet MSL)	12/12/07 Depth To Water (feet)	12/12/07 Groundwater Elevation (feet MSL)
<b>On-Site Monitoring Wells</b>																
MMW-P-01 <sup>1</sup>	9/28/2005	715.79	28	18.00 - 28.00			19.51	696.28	18.17	697.62	18.95	696.84	19.69	696.10	19.13	696.66
MMW-P-02 <sup>1</sup>	9/27/2005	716.70	30	20.00 - 30.00			20.78	695.92	19.13	697.57	19.96	696.74	20.90	695.80	20.42	696.28
MMW-P-03S <sup>1</sup>	9/26/2005	716.55	28	18.00 - 28.00			20.60	695.95	19.03	697.52	19.79	696.76	20.79	695.76	20.19	696.36
MMW-P-03D <sup>1</sup>	9/27/2005	716.45	35	25.00 - 35.00			20.49	695.96	18.93	697.52	19.70	696.75	20.63	695.82	20.10	696.35
MMW-P-04 <sup>1</sup>	9/26/2005	716.27	28	18.00 - 28.00			20.27	696.00	18.77	697.50	19.51	696.76	20.49	695.78	xx	696.56*
MMW-P-05 <sup>1</sup>	9/26/2005	716.12	28	18.00 - 28.00			19.99	696.13	18.58	697.54	19.31	696.81	20.14	695.98	19.57	696.55
MMW-P-06 <sup>1</sup>	9/28/2005	716.50	28	18.00 - 28.00			20.42	696.08	18.94	697.56	19.70	696.80	20.57	695.93	20.06	696.44
MMW-P-07 <sup>1</sup>	1/11/2007	715.30	28	18.00 - 28.00					17.48	697.82	18.30	697.10	18.84	696.46	18.17	697.13
MMW-P-08 <sup>1</sup>	1/11/2007	715.22	28	18.00 - 28.00					17.33	697.89	18.09	697.13	18.61	696.61	18.03	697.19
MMW-P-10S <sup>1</sup>	6/1/2007	714.59	28	18.00 - 28.00							17.70	696.89	18.30	695.19	17.58	697.01
MMW-P-10D <sup>1</sup>	6/1/2007	714.98	38	28.00 - 38.00							18.09	696.89	18.69	694.86	17.95	697.03
<b>Off-Site Monitoring Well (Cemetery ROW)</b>																
MMW-P-09S <sup>1</sup>	1/29/2007	715.36	28	18.00 - 28.00					18.94	696.42	19.59	695.77	20.17	696.29	19.98	695.38
MMW-P-09D <sup>1</sup>	5/31/2007	715.21	45	35.00 - 45.00							19.40	695.81	20.35	696.29	19.76	695.45
<b>Off-Site Monitoring Wells (Keramida)</b>																
MW-167S <sup>1</sup>	3/21/2001	716.25	21.77	12.00 - 22.00			18.78	697.47	17.74	698.51						
MW-167D <sup>1</sup>	1/11/2002	716.25	32.97	28.00 - 33.00			18.80	697.45	17.81	698.44						
MW-168S <sup>1</sup>	1/18/2002	714.79	21.92	11.92 - 21.92			18.09	696.70	17.19	697.60	17.97	696.82	51.73	684.39	17.32	697.47
MW-168D <sup>1</sup>	1/15/2002	714.71	31.02	21.02 - 31.02			18.00	696.71	17.07	697.64	17.87	696.84	53.11	684.47	17.22	697.49
MW-169S <sup>1</sup>	1/16/2002	715.95	25	15.00 - 25.00			20.80	695.15	18.92	697.03						
MW-169D <sup>1</sup>	1/16/2002	715.23	38	32.00 - 37.00			20.77	694.46	18.87	696.36						
MW-170S <sup>1</sup>	1/16/2002	717.4	27	17.00 - 27.00					19.41	697.99						
MW-170D <sup>1</sup>	1/16/2002	717.34	39	34.00 - 39.00					19.35	697.99						
MW-171S <sup>1</sup>	1/22/2002	711.83	22	12.00 - 22.00					15.04	696.79						

[illegible]



Well ID	Sample Date	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	Chloroform	Vinyl chloride	Methylene chloride	Naphthalene	1,2,3-Trichloro benzene	Toluene	Acetone
		ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
MMW-1S	9/10/2004	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25
MMW-1S	11/9/2005	130	8.3	< 5.0	< 5.0	< 5.0	0.8	< 5.0	< 5.0	< 5.0	< 5.0	< 25
MMW-1S	9/5/2006	200	13	< 5.0	< 5.0	< 5.0	4.6	< 5.0	< 5.0	< 5.0	< 5.0	< 25
MMW-2S	9/10/2004	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25
MMW-2S	11/9/2005	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0	5.2	< 5.0	< 5.0	< 5.0	< 25
MMW-2S	9/5/2006	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0	5.2	< 5.0	< 5.0	< 5.0	< 25
MMW-3S	9/10/2004	< 5.0	5.2	< 5.0	< 5.0	< 5.0	< 2.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25
MMW-3S	11/9/2005	< 5.0	28	5.4	< 5.0	< 5.0	< 2.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25
MMW-3S	9/5/2006	< 5.0	23	7.4	< 5.0	< 5.0	< 2.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25
MMW-4D	9/10/2004	< 5.0	< 5.0	980	< 5.0	< 5.0	200	< 5.0	< 5.0	< 5.0	< 5.0	< 25
MMW-4D	11/10/2005	< 5.0	< 5.0	850	< 5.0	< 5.0	200	< 5.0	< 5.0	< 5.0	< 5.0	< 25
MMW-4D	9/5/2006	< 5.0	< 5.0	1100	2.3 J	< 5.0	220	< 5.0	< 5.0	< 5.0	< 5.0	< 25
MMW-5D	9/10/2004	< 5.0	< 5.0	3000	13	< 5.0	270	< 5.0	< 5.0	< 5.0	< 5.0	< 25
MMW-5D	11/10/2005	< 5.0	< 5.0	3000	19	< 5.0	100	< 5.0	< 5.0	< 5.0	< 5.0	< 25
MMW-5D	9/5/2006	< 5.0	< 5.0	2800	< 5.0	< 5.0	170	41 J	< 5.0	< 5.0	< 5.0	< 250
MMW-6D	9/10/2004	< 5.0	< 5.0	540	< 5.0	< 5.0	000	< 5.0	< 5.0	< 5.0	< 5.0	< 25
MMW-6D	11/10/2005	< 5.0	< 5.0	750	< 5.0	< 5.0	700	7.2	< 5.0	< 5.0	< 5.0	< 25
MMW-6D	9/5/2006	< 5.0	< 5.0	300	< 5.0	< 5.0	000	< 5.0	< 5.0	< 5.0	< 5.0	< 25
MMW-7S	9/10/2004	< 5.0	< 5.0	8.5	< 5.0	< 5.0	< 2.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25
MMW-7S	11/9/2005	< 5.0	< 5.0	9.5	< 5.0	< 5.0	< 2.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25
MMW-7S	9/5/2006	< 5.0	< 5.0	5.8	< 5.0	< 5.0	4.5	< 5.0	< 5.0	< 5.0	< 5.0	< 25
IDEM RISC 2006 Default Industrial Cleanup Level	-	55	31	1,000	2,890	1,000	4	300	2,000	NA	20,000	92,000
IDEM RISC 2006 Default Residential Cleanup Level	-	5	5	70	100	80	2	5	8.3	NA	1,000	950

Notes: All Values Over IDEM RISC Industrial Default Cleanup Level shown in RED  
All Values Over IDEM RISC Residential Default Cleanup Level shown in BLUE  
PCE = Tetrachloroethene; TCE = Trichloroethene; cis-1,2-DCE = cis-1,2-Dichloroethene; trans-1,2-DCE = trans-1,2-Dichloroethene

Table 3  
Soil Analytical Results  
Phase II Investigation  
Michigan Plaza  
Indianapolis, Indiana  
MUNDELL Job No.: M01046

Sample	Sample Date	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	Chloroform	Vinyl chloride
		ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
GP-01 (15.5')	8/18/2004	< 5.0	< 5.0	5.4	< 5.0	< 5.0	< 2.0
GP-02 (7')	8/18/2004	35	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0
GP-03 (16')	8/18/2004	230	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0
GP-04 (16')	8/18/2004	200	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0
GP-05 (17')	8/18/2004	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0
IDEM RISC 2006 Default Industrial Cleanup Level	-	540	82	5,800	14,000	1,200	13
IDEM RISC 2006 Default Residential Cleanup Level	-	58	57	405	888	470	13

**Note:**

All Values Over IDEM RISC Industrial Default Cleanup Level shown in **RED**

All Values Over IDEM RISC Residential Default Cleanup Level shown in **BLUE**

PCE = Tetrachloroethene; TCE = Trichloroethene; cis-1,2-DCE = cis-1,2-Dichloroethene; trans-1,2-DCE = trans-1,2-Dichloroethene

Data on this table was originally presented as Table 1 in MUNDELL's Phase II ESA, dated February 16, 2005

**Table 4**  
**Groundwater Analytical Results**  
**Phase II Investigation**  
**Michigan Plaza**  
**Indianapolis, Indiana**  
**MUNDELL Job No.: M01046**

Sample	Sample Date	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	Chloroform	Vinyl chloride	Methylene chloride	Toluene	Acetone	TVOHs *
		ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
GP-01-21'	8/18/2004	6.8	128	130	12	< 5.0	< 2.0	7.7	12	< 25	105
GP-01-30'	8/18/2004	< 5.0	6.1	25	< 5.0	< 5.0	6.1	8.8	11	< 25	9.1
GP-02-12'	8/18/2004	< 5.0	< 5.0	34	< 5.0	9.3	< 2.0	8.6	11	49	19.4
GP-03-20'	8/18/2004	730	< 5.0	79	9.2	< 5.0	< 2.0	7.6	12	< 25	360
GP-03-30'	8/18/2004	900	< 5.0	88	10	< 5.0	< 2.0	7.6	12	< 25	117
GP-03-40'	8/18/2004	11	< 5.0	< 5.0	< 5.0	< 5.0	4.1	< 5.0	< 5.0	< 25	0
GP-04-22'	8/18/2004	23	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0	< 5.0	< 5.0	< 25	0
GP-05-22'	8/18/2004	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0	< 5.0	< 5.0	< 25	0
IDEM RISC 2006 Default Industrial Cleanup Level	-	35	31	1,000	2,000	1,000	2	380	20,000	82,000	-
IDEM RISC 2006 Default Residential Cleanup Level	-	5	5	70	100	80	2	5	1,000	350	-

**Note:**

All Values Over IDEM RISC Default Industrial Cleanup Level in **RED**

All Values Over IDEM RISC Default Residential Cleanup Level in **BLUE**

PCE = Tetrachloroethene; TCE = Trichloroethene; cis-1,2-DCE = cis-1,2-Dichloroethene; trans-1,2-DCE = trans-1,2-Dichloroethene

\*TVOHs = Total Volatile Organic Halides (results from SDI Quick Test = Sum of TCE, PCE and 1,1,1-Trichloroethene)

Date on this table was originally presented on Table 2 in MUNDELL's Phase II ESA, dated February 16, 2005

Table 5a  
Soil Analytical Results  
Further Site Characterization  
Michigan Plaza  
Indianapolis, Indiana  
MUNDELL Job No.: M01046

Sample (Depth in feet)	Sample Date	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	Vinyl chloride
		ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
TP-3-1 (2')	4/27/2005	49	< 5.0	< 5.0	< 5.0	< 2.0
TP-3-2 (2')	4/27/2005	73	< 5.0	< 5.0	< 5.0	< 2.0
TP-3-3 (4')	4/27/2005	9.6	< 5.0	< 5.0	< 5.0	< 2.0
TP-3-4 (4')	4/27/2005	67	< 5.0	< 5.0	< 5.0	< 2.0
TP-3-5 (6')	4/27/2005	60	< 5.0	< 5.0	< 5.0	< 2.0
TP-3-6 (6')	4/27/2005	81	< 5.0	< 5.0	< 5.0	< 2.0
TP-3-7 (6')	4/27/2005	53	< 5.0	< 5.0	< 5.0	< 2.0
IDEM RISC 2006 Default Industrial Cleanup Level	-	648	82	5,800	14,000	13
IDEM RISC 2006 Default Residential Cleanup Level	-	58	57	400	680	13

**Note:**

All Values Over IDEM RISC Industrial Default Cleanup Level shown in **RED**

All Values Over IDEM RISC Residential Default Cleanup Level shown in **BLUE**

PCE = Tetrachloroethene; TCE = Trichloroethene; cis-1,2-DCE = cis-1,2-Dichloroethene; trans-1,2-DCE = trans-1,2-Dichloroethene

Data on this table was originally presented as Table 1 (**Appendix I**) in MUNDELL's Further Site Characterization Report, dated May 10, 2006

Table 5b  
Soil Analytical Results  
Further Site Characterization  
Michigan Plaza  
Indianapolis, Indiana  
MUNDELL Job No.: M01046

Sample	Sample Date	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	Chloroform	Vinyl chloride
		ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
GP-06 (9-10')	9/26/2005	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0
GP-06 (13-14')	9/26/2005	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0
IDEM RISC 2006 Default Industrial Cleanup Level	-	640	82	3,800	14,000	1,200	13
IDEM RISC 2006 Default Residential Cleanup Level	-	58	57	400	680	470	13

**Note:**

All Values Over IDEM RISC Industrial Default Cleanup Level shown in **RED**

All Values Over IDEM RISC Residential Default Cleanup Level shown in **BLUE**

PCE = Tetrachloroethene; TCE = Trichloroethene; cis-1,2-DCE = cis-1,2-Dichloroethene; trans-1,2-DCE = trans-1,2-Dichloroethene

Data on this table was originally presented as Table 5 in MUNDELL's Further Site Characterization Report, dated May 10, 2006



Table 8  
Groundwater Analytical Results  
Further Site Characterization  
Michigan Plaza Monitoring Wells Sampling  
Indianapolis, Indiana  
MUNDELL Job No. 981666

Well ID	Sample Date	PCE	TCE	vinyl-CHLOR	trans-1,2-DCE	Dichloroeth	Vinyl chloride	Methylene chloride	Heptachlor	1,1,1-Trichloroethane	Toluene	Xylenes	THCHs
		ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
Groundwater Sampling													
GP-06 (27)	6/26/2006	< 0.5	< 0.5	200	30	< 0.5	0.4	< 0.5	0.8	0.2	< 0.5	< 0.5	ND
GP-06 (30)	6/26/2006	< 0.5	< 0.5	80	0.2	< 0.5	10	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	ND
GP-07 (30)	6/26/2006	4100	110	210	30	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	ND
GP-08 (20)	6/26/2006	10	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	ND
Off-Site Monitoring Wells													
MWW-P-01	11/9/2005	0.1	0.05	100	0.0	<0.0	0.0	<0.0	<0.0	<0.0	<0.0	<0.0	NA
MWW-P-02	11/9/2005	0.0	<0.0	0.1	0.0	<0.0	0.0	<0.0	<0.0	<0.0	<0.0	<0.0	NA
MWW-P-03A	11/9/2005	110	<0.0	0.1	0.0	<0.0	<0.0	<0.0	<0.0	<0.0	<0.0	<0.0	NA
MWW-P-03B	11/9/2005	0.0	<0.0	0.1	<0.0	<0.0	0.0	<0.0	<0.0	<0.0	<0.0	<0.0	NA
MWW-P-04	11/9/2005	100	<0.0	10.0	0.0	<0.0	0.0	<0.0	<0.0	<0.0	<0.0	<0.0	NA
MWW-P-05	11/9/2005	<0.0	<0.0	0.2	<0.0	<0.0	<0.0	<0.0	<0.0	<0.0	<0.0	<0.0	NA
MWW-P-06	11/9/2005	<0.0	<0.0	0.0	0.0	<0.0	0.1	<0.0	<0.0	<0.0	<0.0	<0.0	NA
Off-Site Monitoring Wells													
MW-16/5	11/17/2005	<0.0	<0.0	100	0.0	<0.0	110	<0.0	<0.0	<0.0	<0.0	<0.0	NA
MW-16/6	11/17/2005	<0.0	<0.0	<0.0	<0.0	<0.0	0.0	<0.0	<0.0	<0.0	<0.0	<0.0	NA
MW-16/8	11/17/2005	<0.0	<0.0	0.0	<0.0	<0.0	0.0	<0.0	<0.0	<0.0	<0.0	<0.0	NA
MW-16/9	11/17/2005	200	0.0	0.0	<0.0	<0.0	0.0	<0.0	<0.0	<0.0	<0.0	<0.0	NA
MW-16/10	11/17/2005	<0.0	<0.0	<0.0	<0.0	<0.0	0.0	<0.0	<0.0	<0.0	<0.0	<0.0	NA
MW-16/11	11/17/2005	<0.0	<0.0	<0.0	<0.0	<0.0	<0.0	<0.0	<0.0	<0.0	<0.0	<0.0	NA
ICEM RSC 2006 Default Industrial Cleanup Level													
ICEM RSC 2006 Default Industrial Cleanup Level	-	0.1	0.1	1,000	0.001	0.001	0.0	0.001	0.001	0.0	0.001	0.001	-
ICEM RSC 2006 Default Residential Cleanup Level													
ICEM RSC 2006 Default Residential Cleanup Level	-	0	0	70	0.0	0.0	0	0	0.0	0.0	1,000	0.0	-

Notes:

All Values Over IDEM RSC Default Industrial Cleanup Level in **RED**

All Values Over IDEM RSC Default Residential Cleanup Level in **BLUE**

PCE = Trichloroethylene; TCE = Trichloroethene; vin-1,2-DCE = vinyl-1,2-Dichloroethene; trans-1,2-DCE = trans-1,2-Dichloroethene

\*THCHs = Total Hexachloro Cyclopentadiene (results from SEM Quick Test = Sum of TCE, PCE and 1,1,1-Trichloroethane)

Data for this MW was originally presented as Table B in MUNDILL's Turbine Site Characterization Report, dated May 10, 2006

NA = Not Applicable, Test NA and/or

**Table 7**  
**Soil Analytical Results**  
**Further Site Characterization**  
**Michigan Meadows Apartments**  
**Indianapolis, Indiana**  
**MUNDELL Job No.: M01046**

Sample	Sample Date	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	Chloroform	Vinyl chloride
		ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
GP-A-01 (4-5')	9/26/2006	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0
GP-A-02 (7-8')	9/27/2006	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0
IDEM RISC 2006 Default Industrial Cleanup Level	-	640	82	5,600	14,600	1,250	13
IDEM RISC 2006 Default Residential Cleanup Level	-	58	57	400	680	470	13

**Note:**

All Values Over IDEM RISC Industrial Default Cleanup Level shown in **RED**

All Values Over IDEM RISC Residential Default Cleanup Level shown in **BLUE**

PCE = Tetrachloroethene; TCE = Trichloroethene; cis-1,2-DCE = cis-1,2-Dichloroethene; trans-1,2-DCE = trans-1,2-Dichloroethene

Data on this table was originally presented as Table 5b in MUNDELL's Further Site Characterization Report, dated May 10, 2006

**Table 6**  
**Groundwater Analytical Results**  
**Further Site Characterization**  
**Michigan Meadows Apartments - Geoprobe Sampling**  
**Indianapolis, Indiana**  
**MUNDELL Job No.: 881046**

Sample	Sample Date	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	Chloroform	Vinyl chloride	Methylene chloride	Naphthalene	1,2,3-Trichloro benzene	Toluene	Xylenes	TVOHs *
		ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
GP-A-01 (16-20)	9/26/2008	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25	0.0
GP-A-01 (26-30)	9/26/2008	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	18	< 5.0	< 5.0	< 5.0	< 5.0	< 25	0.0
GP-A-01 (36-40)	9/26/2008	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	93	< 5.0	< 5.0	< 5.0	< 5.0	< 25	0.0
GP-A-02 (16-20)	9/26/2008	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25	0.0
GP-A-02 (26-30)	9/26/2008	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25	0.0
GP-A-02 (36-40)	9/26/2008	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	12	< 5.0	< 5.0	< 5.0	< 5.0	< 25	0.0
GP-A-03 (30)	9/26/2008	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	32	< 5.0	< 5.0	< 5.0	< 5.0	< 25	NA
GP-A-04 (20)	9/26/2008	38	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25	NA
GP-A-05 (30)	9/26/2008	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25	NA
BMW-15	9/29/2008	329	18	< 5.0	< 5.0	< 5.0	< 2.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25	NA
IDEM RISC 2008 Default Industrial Cleanup Level	-	58	34	1,000	2,000	1,000	2	500	2500	NA1	25,000	50,000	-
IDEM RISC 2008 Default Residential Cleanup Level	-	5	5	70	100	50	2	2	5.2	NA1	1,500	950	-

**Note:**

All Values Over IDEM RISC Default Industrial Cleanup Level in **RED**.  
 All Values Over IDEM RISC Default Residential Cleanup Level in **BLU**.  
 PCE = Trichloroethene; TCE = Trichloroethene; cis-1,2-DCE = cis-1,2-Dichloroethene; trans-1,2-DCE = trans-1,2-Dichloroethene  
 \*TVOHs = Total Volatile Organic Halides (results from ND1 Quick Test) = Sum of TCE, PCE and 1,1,1-Trichloroethene  
 NA = Not Available  
 NA = Not Applicable, Test Not run  
 Data on this table was originally presented on Table 6a in MUNDELL's Further Site Characterization Report, dated May 10, 2009

**Table 9**  
**Historical Sewer Analytical Results**  
**Quarterly Monitoring Progress Report - 2nd Quarter 2007**  
**Michigan Plaza**  
**Indianapolis, Indiana**  
**MUNDELL Job No.: M01046**

Sample	Sample Date	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	Chloroform	Vinyl chloride	Chloro methane	Methylene chloride	Naphthalene	1,2,3-Trichloro benzene	1,4-Dichloro benzene	Toluene	Acetone
		ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
SS-P-01 (7)	9/30/07	18	<3.0	19	<3.0	86	<2.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	89
	11/8/07	8.3	<3.0	47	<3.0	108	<2.0	<3.0	<3.0	21	<3.0	<3.0	<3.0	130
SS-A-01 (7)	9/30/07	56	<3.0	24	<3.0	44	<2.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
	11/8/07	31	<3.0	27	<3.0	40	<2.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	60
	4/14/07	<3.0	<3.0	<3.0	<3.0	11	<2.0	<3.0	<3.0	<3.0	<3.0	6.8	<3.0	<100
SS-A-02 (7)	9/30/07	<3.0	<3.0	<3.0	<3.0	37	<2.0	<3.0	<3.0	<3.0	<3.0	12	6.8	94
	11/8/07	12	<3.0	<3.0	<3.0	18	<2.0	<3.0	<3.0	<3.0	<3.0	14	<3.0	<25
	4/14/07	<3.0	<3.0	<3.0	<3.0	12	<2.0	<3.0	<3.0	<3.0	<3.0	11	<3.0	<100
SS-A-03 (7)	9/30/07	<3.0	<3.0	<3.0	<3.0	148	<2.0	27	<3.0	<3.0	<3.0	6.7	<3.0	416
	11/8/07	18	<3.0	<3.0	<3.0	18	<2.0	<3.0	<3.0	<3.0	<3.0	18	5.2	<25
	4/14/07	<3.0	<3.0	<3.0	<3.0	18	<2.0	<3.0	<3.0	<3.0	<3.0	18	<3.0	<100
SS-P-1010	11/8/07	<3.0	<3.0	<3.0	<3.0	<3.0	<2.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	87
EDM RISC 2006 Default Industrial Cleanup Level	-	55	31	1000	1000	1000	2	NA <sup>1</sup>	100	1000	50.1	120	10000	82000
EDM RISC 2006 Default Residential Cleanup Level	-	5	5	70	100	80	2	NA <sup>2</sup>	5	5.0	50.1	70	1000	700

**Note:**

All Values Over EDM RISC Default Industrial Cleanup Level in **RED**

All Values Over EDM RISC Default Residential Cleanup Level in **BLUE**

PCE = Trichloroethylene, TCE = Trichloroethene, cis-1,2-DCE = cis-1,2-Dichloroethene, trans-1,2-DCE = trans-1,2-Dichloroethene

\*PCEM = Total Volatile Organic Solubles (results from SEM Quick Test - Sum of PCE, TCE and 1,1,1-Trichloroethane)

NA<sup>1</sup> = Not Available

NA<sup>2</sup> = Not Applicable, Test kit not run

Data on this table was originally presented as Table 5 in MUNDELL'S Quarterly Monitoring Progress Report dated August 16, 2007.

Table 10  
Geoprobe Soil Analytical Results  
Further Site Investigation Addendum 1  
Indianapolis, Indiana  
MWDOT Job No. M09048

Well ID	Sample Date	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	Chloroform	Vinyl chloride	Methylene chloride	Naphthalene	1,2,3-Trichlorobenzene
		ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
<b>Geoprobe Sampling (Michigan Meadows Apts)</b>										
GP-A-06, 19-20"	1/11/2007	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0	< 20	< 5.0	< 5.0
GP-A-07, 11-12"	1/12/2007	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0	37	< 5.0	< 5.0
GP-A-08, 14-16"	1/12/2007	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0	< 20	< 5.0	< 5.0
GP-A-09, 15-17"	1/12/2007	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0	33	< 5.0	< 5.0
<b>Monitoring Wells (Michigan Meadows Apts)</b>										
MWW-08, 14-16"	1/11/2007	11,000	18	< 5.0	< 5.0	< 5.0	< 2.0	305	< 5.0	< 5.0
MWW-09, 15-16"	1/11/2007	4,100	112	81	14	< 5.0	< 2.0	< 20	< 5.0	< 5.0
MWW-10B, 14-16"	1/11/2007	18,000	33	< 5.0	< 5.0	< 5.0	< 2.0	< 20	< 5.0	< 5.0
<b>Monitoring Wells (Michigan Plaza)</b>										
MWW-P-07, 19-20"	1/11/2007	36,000	130	64	7.4	< 5.0	< 2.0	< 20	< 5.0	< 5.0
MWW-P-08, 19-20"	1/11/2007	9,000	180	66	5	< 5.0	< 2.0	175	< 5.0	< 5.0
<b>Geoprobe Sampling (IDF site)</b>										
GP-C-01, 3-6"	1/12/2007	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0	< 20	< 5.0	< 5.0
GP-C-01, 19-19"	1/12/2007	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0	< 20	< 5.0	< 5.0
GP-C-02, 15-16"	1/12/2007	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0	< 20	< 5.0	< 5.0
GP-C-03, 14-16"	1/15/2007	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0	< 20	< 5.0	< 5.0
GP-C-04, 16-16"	1/15/2007	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0	< 20	< 5.0	< 5.0
GP-C-05, 17-18"	1/15/2007	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0	< 20	< 5.0	< 5.0
IDEM RISC 2006 Default Industrial Cleanup Level	-	55	31	1,000	2,000	1,000	2	300	2,000	N/A
IDEM RISC 2006 Default Residential Cleanup Level	-	5	5	70	100	50	2	5	0.3	N/A

**Note:**  
 All Values Over IDEM RISC Default Industrial Cleanup Level in **RED**.  
 All Values Over IDEM RISC Default Residential Cleanup Level in **BLUE**.  
 PCE = Trichloroethene; TCE = Trichloroethene; cis-1,2-DCE = cis-1,2-Dichloroethene; trans-1,2-DCE = trans-1,2-Dichloroethene  
 Data on this table was originally presented as Table 3 in MUNDEL's Further Site Investigation Addendum 1, dated April 1, 2007



Table 11  
GeoProbe Groundwater Analytical Results  
Further Site Investigation Addendum I  
Michigan Plaza  
Indianapolis, Indiana  
MWDILL Job No.: M01046

Well ID	Sample Date	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	Chloroform	Vinyl chloride	Methylene chloride	Naphthalene	1,2,3-Trichlorobenzene	Toluene	Aniline
		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Comprehensive Sampling (April)												
GP-A-00_30'	1/11/2007	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	2	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
GP-A-01_30'	1/12/2007	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
GP-A-00_40'	1/12/2007	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
GP-A-00_20'	1/12/2007	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Monitoring Wells (April)												
MMW-01_30'	1/11/2007	1,000	41	0	< 0.5	< 0.5	2	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
MMW-01_30'	1/11/2007	100	< 0.5	300	13	< 0.5	16	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
MMW-01_40'	1/11/2007	200	< 0.5	500	0.1	< 0.5	110	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
MMW-01_20'	1/11/2007	30	30	110	< 0.5	< 0.5	2.8	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
MMW-01_30'	1/11/2007	7.7	< 0.5	14	< 0.5	< 0.5	30	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
MMW-01_40'	1/11/2007	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	10	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
MMW-101_30'	1/12/2007	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
MMW-101_30'	1/12/2007	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	72	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
MMW-101_40'	1/12/2007	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Monitoring Wells (May)												
MMW-P-01_30'	1/11/2007	2,800	91	77	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
MMW-P-01_30'	1/11/2007	74	7.4	61	< 0.5	< 0.5	140	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
MMW-P-01_40'	1/11/2007	376	12	30	< 0.5	< 0.5	37	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
MMW-P-01_30'	1/11/2007	6,000	200	310	0.1	< 0.5	6.2	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
MMW-P-01_30'	1/11/2007	90	120	610	< 0.5	< 0.5	0.1	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
MMW-P-01_40'	1/11/2007	1.00	10	70	< 0.5	< 0.5	0.1	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Comprehensive Sampling (October)												
GP-C-01_30'	1/12/2007	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
GP-C-01_30'	1/12/2007	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
GP-C-01_30' (w/ MMW-P-01_30')	1/12/2007	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
GP-C-04_30'	1/12/2007	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
GP-C-01_30'	1/12/2007	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Monitoring Wells (October)												
MMW-P-01_30'	1/09/2007	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
MMW-P-01_30'	1/09/2007	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	27.8	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
IDH RSC 2008 Default Industrial Cleanup Level	-	25	31	1,000	2,300	1,000	2	200	2000	N/A	20,000	50,000
IDH RSC 2008 Default Residential Cleanup Level	-	0	0	70	100	0	2	5	0.1	N/A	1,000	800
Notes												
All Values (w/ 100% Methylene Chloride Interference Cleanup Level) < 0.01.												
All Values (w/ 100% Methylene Chloride Interference Cleanup Level) < 0.01.												
IDH = Industrial Hygiene, NIOS = National Institute for Occupational Safety and Health, OSHA = Occupational Safety and Health, EPA = Environmental Protection Agency, NYS = New York State, DEC = Department of Environmental Conservation, NYSDEC = New York State Department of Environmental Conservation, NYSDEC = New York State Department of Environmental Conservation, NYSDEC = New York State Department of Environmental Conservation, NYSDEC = New York State Department of Environmental Conservation, NYSDEC = New York State Department of Environmental Conservation, NYSDEC = New York State Department of Environmental Conservation, NYSDEC = New York State Department of Environmental Conservation, NYSDEC = New York State Department of Environmental Conservation, NYSDEC = New York State Department of Environmental Conservation, NYSDEC = New York State Department of Environmental Conservation, NYSDEC = New York State Department of Environmental Conservation, NYSDEC = New York State Department of 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Table 12  
 Surface Water Analytical Results - Little Eagle Creek  
 Further Site Investigation Addendum I  
 Michigan Plaza  
 Indianapolis, Indiana  
 MUNDELL Job No.: M01046  
 February 21, 2007

Well ID	Sample Date	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	Vinyl chloride	1,2,3-Trichloro benzene
		ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
Surface Water Sampling (Little Eagle Creek)							
MSW-1	2/21/2007	<5.0	<5.0	<5.0	<5.0	<2.0	<5.0
MSW-2	2/21/2007	<5.0	<5.0	<5.0	<5.0	<2.0	<5.0
MSW-3	2/21/2007	<5.0	<5.0	<5.0	<5.0	<2.0	<5.0
IDEM RISC 2006 Default Industrial Cleanup Level	-	55	31	1,000	2,000	2	NA
IDEM RISC 2006 Default Residential Cleanup Level	-	5	5	70	100	2	NA

Note:

All Values Over IDEM RISC Default Industrial Cleanup Level in **RED**

All Values Over IDEM RISC Default Residential Cleanup Level in **BLUE**

PCE = Tetrachloroethene; TCE = Trichloroethene; cis-1,2-DCE = cis-1,2-Dichloroethene; trans-1,2-DCE = trans-1,2-Dichloroethene

Data on this table was originally presented as Table 6 in MUNDELL's Further Site Investigation Addendum I, dated April 1, 2007

Table 13  
Historical Monitoring Well Groundwater Analytical  
Remediation Work Plan  
Michigan Plaza  
Indianapolis, Indiana  
MUNDELL Job No.: M01044

Well ID	Sample Date	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	Chloroform	Vinyl chloride
		ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
<b>Monitoring Wells (Apts)</b>							
MMW-15	9/10/2004	3.1	< 5.0	< 5.0	< 5.0	< 5.0	4.1
	3/15/2005	180	10	< 5.0	< 5.0	< 5.0	< 2.0
	11/9/2005	130	8.3	< 5.0	< 5.0	< 5.0	8.9
	9/5/2006	290	15	< 5.0	< 5.0	< 5.0	4.4
	2/22/2007	230	14.9	< 5.0	< 5.0	< 5.0	< 2.0
	6/14/2007	540	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0
	9/19/2007	362	10.5	< 5.0	< 5.0	34.6	< 2.0
	12/13/2007	330	8.3	< 5.0	< 5.0	27	< 2.0
MMW-85	2/22/2007	114	< 5.0	289	13.8	< 5.0	49.4
	6/14/2007	15.9	< 5.0	544	9.8	< 5.0	82.1
	9/19/2007	< 5.0	< 5.0	778	24.6	< 5.0	145
	12/13/2007	5.7	< 5.0	1,000	5.4	< 5.0	200
MMW-95	2/22/2007	78.5	88.4	78.9	< 5.0	< 5.0	< 2.0
	6/14/2007	858	85.7	85.3	< 5.0	< 5.0	< 2.0
	9/19/2007	1,430	112	70.3	8.2	< 5.0	< 2.0
	12/12/2007	37.9.2	17.9.2	1,700	29.8.2	< 5.0	< 20.0
MMW-100	2/22/2007	49.4	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0
	6/14/2007	71.6	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0
	9/19/2007	66	< 5.0	< 5.0	< 5.0	< 5.0	< 2.0
	12/12/2007	127	50	149	< 5.0	< 5.0	< 2.0
MMW-115	6/14/2007	< 5.0	< 5.0	225	8.8	< 5.0	18.6
	9/19/2007	< 5.0	< 5.0	442	21.1	< 5.0	39.7
	12/13/2007	5.1	< 5.0	928	27	< 5.0	49
IDEM RISC Default Industrial Cleanup Level - 2006	-	55	21	1,000	2,000	1,000	1
IDEM RISC Default Residential Cleanup Level - 2006	-	5	5	75	100	50	2

Note:

AB Values Over IDEM RISC Default Industrial Cleanup Level in **RED**

AB Values Over IDEM RISC Default Residential Cleanup Level in **BLUE**

PCE = Tetrachloroethene; TCE = Trichloroethene; cis-1,2-DCE = cis-1,2-Dichloroethene; trans-1,2-DCE = trans-1,2-Dichloroethene

Green Shading indicates areas that are appear to be undergoing reductive dechlorination due to CAP-18 injections

"T" designation indicates concentration was estimated due to high concentration of one parameter requiring dilution in other parameter quantification

"N" indicates analytical parameter was not collected. "NV" indicates data was not valid due to instrument error

**Table 13**  
**Historical Monitoring Well Groundwater Analytical**  
**Remediation Work Plan**  
**Michigan Plaza**  
**Indianapolis, Indiana**  
**MUNDELL Job No.: M01046**

Well ID	Sample Date	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	Chloroform	Vinyl chloride
		ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
Monitoring Wells (Plots)							
MMW-P-01	11/8/2005	33	218	160	9.6	<5.0	76
	2/22/2007	85.2	388	274	16.7	<5.0	28.7
	6/14/2007	111	568	580	18	<5.0	79.4
	9/19/2007	286	322	380	11.5	<5.0	127
	12/14/2007	236	328	240	7.1	<5.0	87
MMW-P-02	11/8/2005	24	<5.0	87	7.5	<5.0	49
	2/22/2007	184	<5.0	39.4	<5.0	<5.0	27.4
	6/14/2007	17.1	<5.0	38	<5.0	<5.0	27.4
	9/19/2007	13.3	<5.0	46.3	5.6	<5.0	58.1
	12/14/2007	9.8	<5.0	48	<5.0	<5.0	83
MMW-P-035	11/8/2005	138	<5.0	97	9.6	<5.0	<5.0
	2/22/2007	289	<5.0	105	18	<5.0	<5.0
	6/14/2007	296	<5.0	96.4	9.2	<5.0	9.3
	9/19/2007	144	<5.0	131	15.8	<5.0	16
	12/14/2007	67	<5.0	88	9.3	<5.0	15
MMW-P-039	11/8/2005	32	<5.0	42	<5.0	<5.0	3
	2/22/2007	48.9	<5.0	37.8	<5.0	38	15.8
	6/14/2007	21.7	<5.0	74.9	<5.0	<5.0	54.3
	9/19/2007	14.3	<5.0	78.1	7.3	<5.0	56.8
	12/14/2007	11	<5.0	48	<5.0	<5.0	28
MMW-P-04	11/8/2005	188	<5.0	<5.0	<5.0	<5.0	<5.0
	2/22/2007	315	<5.0	<5.0	<5.0	<5.0	<5.0
	6/14/2007	388	<5.0	<5.0	<5.0	<5.0	<5.0
	9/19/2007	214	<5.0	<5.0	<5.0	<5.0	<5.0
	12/14/2007	62	<5.0	<5.0	<5.0	<5.0	<5.0
MMW-P-05	11/8/2005	<5.0	<5.0	6.2	<5.0	<5.0	<5.0
	2/22/2007	21.7	<5.0	9.1	<5.0	<5.0	<5.0
	6/14/2007	<5.0	<5.0	18.8	<5.0	<5.0	<5.0
	9/19/2007	<5.0	<5.0	18.8	<5.0	<5.0	<5.0
	12/14/2007	<5.0	<5.0	14.8	<5.0	<5.0	<5.0
MMW-P-06	11/8/2005	<5.0	<5.0	280	24	<5.0	21
	2/22/2007	<5.0	<5.0	158	19.2	<5.0	<5.0
	6/14/2007	<5.0	<5.0	214	22.7	<5.0	13.3
	9/19/2007	<5.0	<5.0	283	38.3	<5.0	24.1
	12/14/2007	<5.0	<5.0	288	48	<5.0	31
IDEM RISC Default Industrial Cleanup Level - 2006	-	50	10	1,000	2,000	1,000	3
IDEM RISC Default Residential Cleanup Level - 2006	-	3	5	75	180	80	1

**Notes:**

All Values Over IDEM RISC Default Industrial Cleanup Level is **RED**

All Values Over IDEM RISC Default Residential Cleanup Level is **BLUE**

PCE = Tetrachloroethene; TCE = Trichloroethene; cis-1,2-DCE = cis-1,2-Dichloroethene; trans-1,2-DCE = trans-1,2-Dichloroethene

Green Shading indicates areas that are appear to be undergoing redox reduction due to CAP-18 injections

"T" designation indicates concentration was estimated due to high concentration of one parameter requiring dilution on other parameter quantities

"\*" indicates geochemical parameter was not collected, "NV" indicates data was not valid due to equipment error

Table 13  
Historical Monitoring Well Groundwater Analytical  
Remediation Work Plan  
Michigan Plaza  
Indianapolis, Indiana  
MUNDELL Job No.: M01046

Well ID	Sample Date	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	Chloroform	Vinyl Chloride
		ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
Monitoring Wells (Phase)							
MMW-P-07	2/23/2007	1,940	81.8	82	8.8	<5.0	<5.0
	6/14/2007	2,850	90	81.5	<50.0	<50.0	<20.0
	9/28/2007	5,200	108	121	16.1	<5.0	5
	12/13/2007	5,540	157	958	8.8	7.4	40
MMW-P-08	2/23/2007	6,280	281	240	26.7	<5.0	<2.0
	6/14/2007	6,440	110	197	<50.0	<50.0	<20.0
	9/28/2007	5,750	691	201	25.3	<5.0	2.3
	12/14/2007	390	119	5,800	<50.0	<50.0	<20.0
MMW-P-09S	5/22/2007	18.0	<5.0	<5.0	<5.0	<5.0	<2.0
	6/14/2007	<5.0	<5.0	<5.0	<5.0	<5.0	<2.0
	9/19/2007	<5.0	<5.0	<5.0	<5.0	<5.0	<2.0
	12/13/2007	<5.0	<5.0	<5.0	<5.0	<5.0	<2.0
MMW-P-09D	6/14/2007	<5.0	<5.0	<5.0	<5.0	<5.0	46.2
	9/19/2007	<5.0	<5.0	<5.0	<5.0	<5.0	83.1
	12/13/2007	<5.0	<5.0	<5.0	<5.0	<5.0	71
MMW-P-10S	6/14/2007	36.1	36.3	61.8	6.9	<5.0	<2.0
	5/6/2007	87.9	54.9	92.1	38.2	<5.0	<2.0
	9/19/2007	192	82.6	126	14.4	<5.0	<2.0
	12/14/2007	71	<5.0	<5.0	<5.0	<5.0	2.6
MMW-P-10D	6/14/2007	<5.0	18.6	481	7.7	<5.0	88.7
	5/6/2007	<5.0	<5.0	498	8	<5.0	118
	9/19/2007	<5.0	<5.0	358	<5.0	<5.0	56.1
	12/14/2007	<5.0	<5.0	278	<5.0	<5.0	77
Groundwater Monitoring Wells (Off-site)							
MW-168S	11/7/2005	388	16	83	<5.0	<5.0	1
	3/21/2007	36.1	8.8	133	<5.0	<5.0	29.6
	6/14/2007	<5.0	<5.0	48.8	<5.0	<5.0	34
	9/19/2007	33.6	8	82.4	<5.0	<5.0	3.8
	12/13/2007	52	14	78	<5.0	<5.0	6.2
MW-168D	11/7/2005	<5.0	<5.0	6.8	<5.0	<5.0	49
	3/21/2007	<5.0	<5.0	8.4	<5.0	<5.0	58.1
	6/14/2007	<5.0	<5.0	5.2	<5.0	<5.0	47.8
	9/19/2007	<5.0	<5.0	<5.0	<5.0	<5.0	88.7
	12/13/2007	<5.0	<5.0	<5.0	<5.0	<5.0	74
IDEM RISC Default Industrial Cleanup Level - 2006	<5	55	31	1,000	1,000	1,000	1
IDEM RISC Default Residential Cleanup Level - 2006	<5	1	1	70	100	80	1

Note:

All Values Over IDEM RISC Default Industrial Cleanup Level is RED

All Values Over IDEM RISC Default Residential Cleanup Level is BLUE

PCE = Tetrachloroethane; TCE = Trichloroethane; cis-1,2-DCE = cis-1,2-Dichloroethane; trans-1,2-DCE = trans-1,2-Dichloroethane

Green Shading indicates areas that are appear to be undergoing redoxactive dechlorination due to CAP-18 injections

\*? designation indicates concentration was estimated due to high concentration of one parameter requiring dilution on other parameter quantifications

\*? indicates geochemical parameter was not collected, "NV" indicates data was not valid due to equipment error

Table 14  
Soil Analytical Results  
May 2007 Delineation and October 2007 Excavation  
Remediation Work Plan  
Michigan Plaza  
Indianapolis, Indiana  
MUNDELL Job No.: M01046

Sample	Sample Date	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	Chloroform	Violet Chloride
		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
MAIR-9-105, 14-17	5/5/2007	10.8	10.4	< 5.7	< 5.7	< 3.2	< 3.2
Sewer Exc. (F)	10/1/2007	243	37.7	11.7	< 3.6	< 3.6	< 3.6
Sewer Exc. (F)	10/1/2007	2,300	36.4	15.8	< 3.5	< 3.5	< 3.5
IDEM RBC Default Industrial Cleanup Level	-	640	87	5,000	14,000	1,200	15
IDEM RBC Default Residential Cleanup Level	-	38	67	480	680	470	13

**Note:**

All Values Over IDEM RBC Industrial Default Cleanup Level shown in RED

All Values Over IDEM RBC Residential Default Cleanup Level shown in BLUE

PCE = Trichloroethene; TCE = Trichloroethene; cis-1,2-DCE = cis-1,2-Dichloroethene; trans-1,2-DCE = trans-1,2-Dichloroethene



**Table 15**  
**Evaluation of Remedial Alternatives**  
Michigan Plaza  
3801-3873 W. Michigan Street  
Indianapolis, Indiana  
MUNDELL Project No.: M01046

Remediation Options	Why selected as an option?	Extent of remediation effort	Technical feasibility	Projected contaminant removal and treatment rates	Protectiveness of human health	Cleanup criteria	Ability to achieve cleanup criteria	Community acceptance	Anticipated volume of materials to be treated	Ease of technology application/implementation	Dimensions of major technologies and space limitations	Process parameters	Cleanup time frame	Transportation distances	O&M cost	Other considerations
Monitored Natural Attenuation	Treats GW	Long	Contaminant concentrations show some degradation to daughter products, but geochemically, aquifer may not maintain suitable environment for full degradation	Slow	Protective	IDEM RISC 2006 Commercial/Industrial	May not be able to decrease COC concentrations down to cleanup objectives	No impact to surrounding residents	Unknown	Easy; no action needed monitor geochemical conditions	None	In-Situ Geochemical environment	At least 7 years for monitoring	NA	None	Pre-injection MNA rate was not rapid enough at Site to achieve cleanup in a reasonable time frame.
Air Sparging with Ozone Injection and Soil Vapor Extraction	Treats GW and Soil	Moderate in sandy soils similar to Site	Contaminant concentrations were decreasing from 1995-2004, but geochemically, aquifer may not maintain suitable environment for full degradation	Slow	Protective	IDEM RISC 2006 Commercial/Industrial	May not be able to decrease COC concentrations down to cleanup objectives	May have been intrusive to businesses and residents	Unknown	Complicated; requires extensive construction	Space for permanent structure required	Soil type; depth to groundwater; depth of impacts; Vacuum/blower pressures, effective radius	Usually 3-5 years	NA	High	Trenching and system Layout would have been too intrusive and extensive with roadway and 3 areas to treat.
Chemical Oxidation (Ozone/Fenton's Reagent)	Treats GW	Short when effectively distributed; long when not.	Chemical oxidation can treat halogenated aliphatic compounds but it must be distributed to impacts to allow rapid to allow for chemical reaction.	Rapid - in area of immediate injection; Slow in areas not reached by injection.	Protective	IDEM RISC 2006 Commercial/Industrial	Should be able to decrease all COC concentrations down to cleanup objectives if distributed effectively	No impact to surrounding residents; however, can have health and safety concerns.	Unknown	Moderate; injection is moderate in ease: health and safety issues.	Need temporary access for drilling rig and tanker trucks	In-situ geochemical environment, soil type	On the order of 5 years post injection.	NA	None	High initial costs; Site Source Areas are spread out; chemical distribution will be difficult under roadways/buildings and likely not effective; multiple injections
In-Situ Bioremediation (CAP18™)	Treats GW	Moderate	Presence of daughter products indicates subsurface conducive to degradation; geochemistry is reasonable and can be enhanced; potential for long-lasting injection.	Moderate - depending on distribution of parent chemicals and injection spacing.	Protective	IDEM RISC 2006 Commercial/Industrial	Can achieve cleanup criteria if product distribution is effective.	No impact to surrounding residents	Unknown	Easy to Moderate; injection is relatively simple, low pressure allowed.	Need temporary access for drilling rig	In-situ geochemical environment, soil type	On the order of 5 years post injection.	NA	None	Moderate initial cost; Product injection spacing as cascade should allow distribution under roadway and building. Groundwater and background conditions may require multiple injections depending on response

NOTES:  
GW = Groundwater  
NA= Not applicable

**Table 16**  
**Indicator Compounds Toxicity Characteristics**  
**Remediation Work Plan**  
Michigan Plaza  
3801-3823 West Michigan Street  
Indianapolis, IN  
Mundell Project # M01046

Compound	MW	KOC	KOW	SOL	H'	Di,a	Reference Doses		Cancer Slope Factors	
							Oral	Inhalation	Oral	Inhalation
	g/g-mol	L/Kg	(mg/L)/(mg/L)	mg/L	dimensionless	cm <sup>2</sup> /s	mg/kg day	mg/kg-day	1/(mg/kg-d)	1/(µg/kg-d)
Tetrachloroethene (PCE)	165.8	155	468	200	0.754	0.072	0.01	0.01	0.052	0.021
Trichloroethene (TCE)	131.4	166	513	1100	0.422	0.079	0.003	0.01	0.1	0.054
cis-1,2-Dichloroethene (cis-1,2-DCE)	97.0	35.5	72.4	3500	0.167	0.0736	0.01	0.01	NL	NL
trans-1,2-Dichloroethene (trans-1,2-DCE)	97.0	52.5	117	6300	0.385	0.0707	0.02	0.02	NL	NL
Vinyl Chloride (VC)	62.5	18.6	31.6	2760	1.11	0.106	0.003	0.029	1.5	0.031

MW -Molecular Weight

KOC -Organic Carbon Partition Coefficient

KOW -Octanol/Water Partition Coefficient

SOL -Aqueous Solubility

H' -Dimensionless Henry's Law Constant (H' = Henry's Law Constant(atm-m<sup>3</sup>/mol) x 41)

Di,a -Vapor Phase Diffusion Coefficient

NL is not listed in RISC Technical Guide

Values for MW, KOC, SOL, H', Di, Reference Doses, and Cancer Slope Factors are from the RISC Technical Guide Appendix A 2006 Tables.

Values for KOW are from the EPA Soil Screening Guidance Technical Guide (July 1996, EPA/540/R-95/128)

**Table 17**  
**Geochemical Parameters**  
**Sample Collection Date: October 22, 2004**  
**Phase II Investigation**  
**Michigan Meadows**  
**Indianapolis, IN**  
**MUNDELL Project No.: M01046**

<b>Well</b>	<b>Temperature (F)</b>	<b>ORP (mV)</b>	<b>pH (pH)</b>	<b>Dissolved DO (ug/L)</b>	<b>Conductivity (uS)</b>
MMW-3S	61	350	7	9,700	810
MMW-4D	59	-30	7	10,000	1,200
MMW-5D	62	-25	7	10,000	750
MMW-6D	66	-54	7	9,000	590
MMW-7S	69	12	6	9,000	710

Notes:

1) Geochemical parameters were monitored with the Troll 9000 multi-parameter meter through an inline flow cell until dissolved oxygen (DO), temperature, pH, conductivity, and oxidation reduction potential (ORP) values stabilized.

2) Data was rounded to two (2) significant figures.

**Table 18**  
**Expanded Geochemical Parameters Evaluation**  
**Sample Collection Date: April 2007**  
**Remediation work Plan**  
**Michigan Plaza**  
**Indianapolis, IN**  
**MUNDELL Project No.: M01046**

Well	Temperature (F)	ORP (mV)	pH (pH)	Dissolved Oxygen (ug/L)	Conductivity (uS)	Total Hardness (mg/L)	Total Iron (mg/L)	Nitrate (mg/L)	Sulfate (mg/L)
MMW-1S	58	290	8.0	4,800	920	510	<0.10	13	87
MMW-2S	55	340	7.0	8,200	570	350	5.0	3.0	38
MMW-8S	60	-2.0	8.2	2,300	970	420	14	<0.10	240
MMW-9S	58	200	7.5	2,900	1,400	770	<0.10	2.4	250
MMW-P-08	59	330	7.0	4,000	1,700	720	0.01	7.7	190

Notes:

1) A 'Sample Pro Portable MicroPurge Pump' connected to a Troll 9000 multi-parameter meter was utilized for uniform purging. Geochemical parameters were monitored with the Troll 9000 through an inline flow cell until dissolved oxygen (DO), temperature, pH

2) Data was rounded to two (2) significant figures.

**TABLE 19c**  
**AIR SAMPLING ANALYTICAL RESULTS - TO-15 SIM ANALYSIS**  
 Sampling Events - April 2003, October 2004, September 2005, October 2006  
 Further Site Characterization  
 Michigan Plaza Shopping Center  
 Indianapolis, Indiana  
 MUNDELL Project No. M01044

Sample ID	Sample Date	Tetrachloroethene (PCE)			Trichloroethene (TCE)			cis-1,2-Dichloroethene (cis-1,2-DCE)			Vinyl Chloride (VC)		
		ppb	ug/m <sup>3</sup>	mg/m <sup>3</sup>	ppb	ug/m <sup>3</sup>	mg/m <sup>3</sup>	ppb	ug/m <sup>3</sup>	mg/m <sup>3</sup>	ppb	ug/m <sup>3</sup>	mg/m <sup>3</sup>
VILLAGE PARKWAY	4/25/2003	38.30	0.00	0.00	0.00	0.00	0.00000	ND	ND	ND	ND	ND	ND
	9/29/2005	20	0.00	0.00	0.01	0.00	0.00000	0.00	0.00	0.00000	0.00	0.00	0.00000
	10/12/2006	0.00	0.00	0.00000	ND	ND	ND	0.000	0.00	0.00000	0.10	0.00	0.00000
PLAZA 3015	4/25/2003	176.72	0.00	0.00	0.43	0.00	0.00000	0.00	0.00	0.00000	ND	ND	ND
	4/26/2003	245.59	0.00	0.00	0.43	0.00	0.00000	0.00	0.00	0.00000	ND	ND	ND
	10/7/2004	16	0.00	0.00	0.10	0.00	0.00000	0.17	0.00	0.00000	0.75	0.00	0.00000
	9/29/2005	42	0.00	0.00	0.10	0.00	0.00000	0.20	0.00	0.00000	0.00	0.00	0.00000
PLAZA 3017	4/25/2003	200	0.00	0.00	0.10	0.00	0.00000		0.10	0.00000	ND	ND	ND
	10/7/2004	26	0.00	0.00	0.10	0.00	0.00000	0.17	0.00	0.00000	0.00	0.00	0.00000
	9/29/2005	76	0.00	0.00	0.00	0.00	0.00000	0.10	0.00	0.00000	0.00	0.00	0.00000
PLAZA 3018 (Merlot Store) (door air)	10/12/2006	3.00	0.00	0.00	ND	ND	ND	0.00	0.00	0.00000	0.00	0.00	0.00000
	10/7/2004	1.70	0.00	0.00	0.00	0.00	0.00000	0.00	0.00	0.00000	0.00	0.00	0.00000
	10/12/2006	0.00	0.00	0.00	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00000
PLAZA 3019 (Merlot Store) (door side)	10/7/2004	1.70	0.00	0.00	0.00	0.00	0.00000	0.00	0.00	0.00000	0.00	0.00	0.00000
PLAZA 3022 (Lawn Service)	10/12/2006	0.00	0.00	0.00	ND	ND	ND	ND	ND	ND	0.00	0.00	0.00000
MDW-5 (grab sample)	4/25/2003	16	0.00	0.00	0.00	0.00	0.00000	0.00	0.00	0.00000	0.00	0.00	0.00000
	10/7/2004	202	0.00	0.00	0.00	0.00	0.00000	0.00	0.00	0.00000	0.00	0.00	0.00000
Ambient Air	10/12/2006	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Note: Results shown as **ND** exceed the draft U.S. EPA guideline, thus shown as **WARNING** exceed IDEM target occupational air concentrations.

Results in **ND** exceed the draft U.S. EPA guideline & the IDEM target residential air concentrations.

Data on this table was originally presented as Table 19c in MUNDELL's Further Site Characterization Report, dated May 15, 2008.

TABLE 19b  
AIR SAMPLING ANALYTICAL RESULTS - TO-15 SIM ANALYSIS  
Michigan Meadows Apartments  
Indianapolis, Indiana  
MUNDELL Project No. M01046

Sample ID	Sample Date	Tetrachloroethene (PCE)			Trichloroethene (TCE)			cis-1,2-Dichloroethene (cis-1,2-DCE)			Vinyl Chloride (VC)		
		ppb v/v	ugm <sup>3</sup>	mg/m <sup>3</sup>	ppb v/v	ugm <sup>3</sup>	mg/m <sup>3</sup>	ppb v/v	ugm <sup>3</sup>	mg/m <sup>3</sup>	ppb v/v	ugm <sup>3</sup>	mg/m <sup>3</sup>
BLDG 10 (basement) (air only room)	4/23/2003	20	196	0.04	0.34	1.94	0.002	0.064	0.22	0.00022	ND	ND	ND
BLDG1APT101(basement)	10/7/2004	6.3	10	0.006	0.21	1.1	0.007	0.17	0.67	0.00067	0.052	0.13	0.00013
BLDG1APT104 (second floor)	10/7/2004	0.00	6.5	0.0006	0.077	0.37	0.00077	0.34	1.5	0.0015	0.046	0.25	0.00025
BLDG1APT105 (3rd floor)	10/7/2004	6.8	10	0.003	0.16	0.36	0.00036	0.13	0.52	0.00052	0.062	0.16	0.00016
BLDG 8 (basement)	4/24/2003	0.00	6.4	0.0004	0.049	0.30	0.00030	0.039	0.30	0.00030	ND	ND	ND
BLDG25APT2002	10/7/2004	0.06	0.37	0.00	0.078	0.40	0.00040	0.17	0.67	0.00	0.046	0.12	0.00012
BLDG25APT2006	10/7/2004	0.899	0.64	0.00064	0.71	0.30	0.00030	0.22	0.67	0.00067	0.068	0.17	0.00017
BLDG25APT2008	10/7/2004	0.36	3.4	0.0034	0.4	2.1	0.00021	0.23	0.91	0.00091	0.066	0.17	0.00017
M200-1	10/7/2004	0.00	1.8	0.0	0.078	0.40	0.00040	ND	ND	ND	0.2	0.21	0.00021
M200-2	10/7/2004	0.31	0.1	0.0	0.066	0.33	0.00033	ND	ND	ND	ND	ND	ND
MAA-1	10/7/2004	0.28	2.2	0.0	0.3	1.3	0.00013	0.33	1.3	0.0013	0.06	0.16	0.00016
MAA-2	10/7/2004	0.21	1.4	0.0014	0.16	0.5	0.0	0.14	0.71	0.00071	0.046	0.12	0.00012
MAA-3	10/7/2004	0.3	2.8	0.0	0.16	0.31	0.00031	0.19	0.63	0.00063	0.053	0.14	0.00014

Note: Results shown in BBT exceed the state U.S. EPA guidelines. These levels are 100x greater than the 100:100 target residential air concentrations.

It should be noted that the analytical results from the (10x Wk.302W) samples are not indicative of "breathing zone" air quality, and comparison to published regulatory standards established for the breathing zone are included here for informational purposes only.



**Table 20**  
**CAP18 Injection Data**  
**August 1 - September 4, 2007**  
**Michigan Plaza**  
**3801-3823 West Michigan Street**  
**Indianapolis, IN**  
**Mundell Project # M01046**

Injection Point	Date of Injection	Depth of Boring (ft)	Depth of Clay till (ft)	Injection Depth Range (ft)	Total Amt CAP18 Injected (gallons)	Total Amt CAP18 Injected (pounds)
<b>Source Area A:</b>						
A1	8/16/07	39	39	17-38	23.5	168.9
A2	8/16/07	37	37	15-36	23.5	168.9
A3	8/16/07	39	NA	17-38	23.5	168.9
A4	8/17/07	42	42	17-41	23.5	168.9
A5	8/17/07	43	43	15-42	23.5	168.9
A6	8/17/07	42	42	17-41	23.5	168.9
A7	8/17/07	44	44	16-43	23.5	168.9
A8	8/17/07	44	44	16-43	23.5	168.9
A9	8/17/07	40	40	15-39	23.5	168.9
A10	8/17/07	39	NA	17-38	23.5	168.9
A11	8/17/07	43	43	15-42	23.5	168.9
A12	8/20/07	52	52	15-51	24.0	172.7
A13	8/20/07	34	34	15-33	23.5	168.9
A14	8/20/07	36	36	17-35	23.5	168.9
A15	8/20/07	36	36	17-35	23.5	168.9
A16	8/20/07	36	36	17-35	23.5	168.9
A17	8/21/07	39	39	17-38	70.4	506.6
A18	8/21/07	36	36	17-35	70.4	506.6
A19	8/21/07	36	36	17-35	70.9	510.4
A20	8/21/07	39	39	17-38	70.4	506.6
A21	8/21/07	36	36	17-35	70.9	510.4
A22	8/22/07	38	38	16-37	70.4	506.6
A23	8/22/07	39	39	17-38	70.4	506.6
A24	8/22/07	37	37	15-36	70.4	506.6
A25	8/22/07	36	36	17-35	70.9	510.4
A26	8/22/07	36	36	17-35	70.9	510.4
A27	8/23/07	36	36	17-35	70.9	510.4
A28	8/23/07	35	35	16-34	70.4	506.6
A29	8/23/07	36	36	17-35	70.9	510.4
A30	8/23/07	35	35	16-34	70.4	506.6
A31	8/23/07	35	35	16-34	70.4	506.6
A32	8/24/07	32	30	16-31	70.4	506.6
A33	8/24/07	34	34	15-33	70.4	506.6
A34	8/24/07	32	32	15-31	23.5	168.9
A35	8/24/07	34	34	15-33	23.5	168.9
A36	8/24/07	34	34	15-33	70.4	506.6
A37	8/24/07	32	32	16-31	70.4	506.6
A38	8/24/07	32	32	15-31	23.5	168.9
A39	9/4/07	36	NA	17-35	58.6	422.1
A40	9/4/07	36	NA	17-35	58.6	422.1
A41	9/4/07	36	NA	17-35	58.6	422.1
<b>TOTAL AMOUNT OF CAP18 INJECTED IN SOURCE AREA A:</b>					<b>1,962.0</b>	<b>14,126.2</b>

**Table 20**  
**CAP18 Injection Data**  
**August 1 - September 4, 2007**  
**Michigan Plaza**  
**3801-3823 West Michigan Street**  
**Indianapolis, IN**  
**Mundell Project # M01046**

Injection Point	Date of Injection	Depth of Boring (ft)	Depth of Clay till (ft)	Injection Depth Range (ft)	Total Amt CAP18 Injected (gallons)	Total Amt CAP18 Injected (pounds)
<b>Source Area B:</b>						
B1	8/1/07	46	38	15-45.5	47.5	342.3
B2	8/1/07	42	NA	14.5-41.5	50.3	362.3
B3	8/2/07	45	39	14-44	47.1	339.2
B4	8/2/07	42	40	14-41	47.3	340.8
B5	8/2/07	40	39	15-39	46.9	337.7
B6	8/2/07	42	40	17-41	48.0	345.4
B7	8/3/07	38	38	16-37	70.9	510.4
B8	8/3/07	38	38	16-37	70.9	510.4
B9	8/3/07	32	31	17-31	23.5	168.9
B10	8/3/07	28	24	15-27	69.3	498.9
B11	8/6/07	30	30	17-29	23.5	168.9
B12	8/6/07	32	31	16-31	71.4	514.2
B13	8/6/07	32	31	16-31	23.5	168.9
B14	8/6/07	32	31	16-31	71.4	514.2
B15	8/6/07	21	21	16-20	23.5	168.9
B16	8/6/07	27	27	17-26	68.2	491.2
B17	8/7/07	31	31	15-30	23.5	168.9
B18	8/7/07	27	27	17-26	70.4	506.6
B19	8/7/07	35	33	15-33	23.5	168.9
B20	8/7/07	39	38	17-38	69.8	502.7
B21	8/8/07	38	38	16-37	70.7	508.9
B22	8/8/07	38	38	16-37	70.7	508.9
B23	8/8/07	37	37	15-36	70.7	508.9
B24	8/8/07	34	34	15-33	70.4	506.6
B25	8/8/07	38	38	15-36	94.3	679.3
B26	8/9/07	35	35	16-34	70.4	506.6
B27	8/9/07	31	31	15-30	70.4	506.6
B28	8/9/07	36	35	17-35	94.9	683.1
B29	8/9/07	36	35	16-34	70.4	506.6
B30	8/9/07	35	35	16-34	70.4	506.6
B31	8/10/07	35	35	16-34	24.0	172.7
B32	8/10/07	36	36	17-35	70.4	506.6
B33	8/10/07	34	34	15-33	70.4	506.6
B34	8/10/07	35	35	16-34	23.5	168.9
B35	8/10/07	36	34	17-35	70.4	506.6
B36	8/13/07	37	37	15-36	23.5	168.9
B37	8/13/07	37	37	15-36	23.5	168.9
B38	8/13/07	36	36	17-35	23.5	168.9
B39	8/13/07	39	39	17-38	23.5	168.9
B40	8/13/07	39	39	17-38	23.5	168.9
B41	8/13/07	38	38	16-37	23.5	168.9
B42	8/13/07	38	38	16-37	23.5	168.9
B43	8/13/07	39	39	17-38	23.5	168.9

**Table 20**  
**CAP18 Injection Data**  
**August 1 - September 4, 2007**  
**Michigan Plaza**  
**3801-3823 West Michigan Street**  
**Indianapolis, IN**  
**Mundell Project # M01046**

Injection Point	Date of Injection	Depth of Boring (ft)	Depth of Clay till (ft)	Injection Depth Range (ft)	Total Amt CAP18 Injected (gallons)	Total Amt CAP18 Injected (pounds)
B44	8/13/07	35	35	16-34	70.4	506.6
B45	8/14/07	40	40	15-39	70.4	506.6
B46	8/14/07	38	38	16-37	70.9	510.4
B47	8/14/07	37	37	15-36	70.9	510.4
B48	8/14/07	36	36	17-35	23.5	168.9
B49	8/15/07	36	NA	17-35	23.5	168.9
B50	8/15/07	34	34	15-33	23.5	168.9
B51	8/15/07	35	35	16-34	23.5	168.9
B52	8/15/07	37	37	15-36	23.5	168.9
B53	8/15/07	36	36	17-35	23.5	168.9
B54	8/15/07	35	35	16-34	23.5	168.9
B55	8/15/07	36	36	17-35	23.5	168.9
B56	8/15/07	40	NA	15-39	61.8	445.2
B57	8/16/07	37	37	15-36	23.5	168.9
B58	8/16/07	36	36	17-35	23.5	168.9
B59	8/16/07	37	37	15-36	23.5	168.9
B60	8/16/07	35	35	16-34	23.5	168.9
TOTAL AMOUNT OF CAP18 INJECTED IN SOURCE AREA B:					2,815.1	20,268.7

Injection Point	Date of Injection	Depth of Boring (ft)	Depth of Clay till (ft)	Injection Depth Range (ft)	Total Amt CAP18 Injected (gallons)	Total Amt CAP18 Injected (pounds)
Source Area C:						
C1	8/27/07	32	32	16-31	70.4	506.6
C2	8/27/07	31	31	15-30	70.4	506.6
C3	8/27/07	32	32	16-31	70.4	506.6
C4	8/27/07	32	NA	16-31	70.4	506.6
C5	8/27/07	34	34	15-33	70.4	506.6
C6	8/27/07	32	NA	16-31	70.4	506.6
C7	8/27/07	34	34	15-33	55.4	399.1
C8	8/28/07	34	34	15-33	55.4	399.1
C9	8/28/07	36	NA	17-35	55.4	399.1
C10	8/28/07	34	NA	15-33	55.4	399.1
C11	8/28/07	36	NA	17-35	55.4	399.1
C12	8/28/07	35	NA	16-34	55.4	399.1
C13	8/28/07	31	NA	15-30	55.4	399.1
C14	8/29/07	32	32	16-31	55.4	399.1
C15	8/29/07	35	35	16-34	55.4	399.1
C16	8/29/07	32	32	16-31	55.4	399.1
C17	8/29/07	32	32	16-31	55.4	399.1
C18	8/29/07	32	32	16-31	55.4	399.1
C19	8/29/07	34	34	15-33	55.4	399.1
C20	8/29/07	34	34	15-33	55.4	399.1
C21	8/30/07	30	NA	17-29	18.4	132.4
C22	8/30/07	32	32	16-31	18.7	134.3
C23	8/30/07	31	NA	15-30	18.4	132.4
C24	8/30/07	32	NA	16-31	18.7	134.3
C25	8/30/07	32	NA	16-31	18.4	132.4
C26	8/30/07	34	NA	15-33	55.4	399.1
C27	8/30/07	34	NA	15-33	18.7	134.3
C28	8/30/07	34	NA	15-33	18.4	132.4
C29	8/30/07	30	30	17-29	55.4	399.1
C30	8/31/07	35	35	16-34	18.7	134.3
C31	8/31/07	36	NA	17-35	18.4	132.4
C32	8/31/07	33	NA	17-32	18.7	134.3
C33	8/31/07	31	31	15-30	55.4	399.1
C34	8/31/07	31	31	15-30	18.4	132.4
C35	8/31/07	31	31	15-30	18.7	134.3
C36	8/31/07	35	35	16-34	18.4	132.4
C37	8/31/07	32	NA	16-31	18.7	134.3
C38	8/31/07	31	31	15-30	55.4	399.1
C39	8/31/07	NA	NA	NA	18.4	132.4
C40	9/4/07	32	NA	16-31	32.0	230.3
TOTAL AMOUNT OF CAP18 INJECTED IN SOURCE AREA C:					1,729.6	12,453.0
TOTAL AMOUNT OF CAP18 INJECTED IN ALL SOURCE AREAS:					6,506.7	46,847.9
NOTE: Amounts are estimates based on field activities conducted from August 1 to September 4, 2007.						

**NOTE:** Amounts are estimates based on field activities conducted from August 1 to September 4, 2007.

**Table 21 - Remediation Progress Schedule**  
**Remediation Work Plan**  
**Michigan Plaza Site**  
**3801-3823 West Michigan Street**  
**Indianapolis, Indiana**  
**MUNDELL Project No. M0104R**

